DOCUMENT: 830-220/001

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Final Agenda

June 8-10, 1986
Winnipeg, Manitoba

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Winnipeg, June 8-10, 1986

AGENDA

June 8

1500 - 2100 Registration, Lobby of the Fort Garry Hotel

1900 - 2100 Reception, hosted by federal, provincial and territorial Ministers, to be held at the Canadian Institute of Industrial Technology. Shuttle bus available from Fort Garry Hotel.

June 9

0800 - 1000 Registration - 7th floor, Fort Garry Hotel

0900 - 0915 Opening of the Forum: Concert Hall - 7th Floor, Fort Garry Hotel
Dr. Stuart Smith, Science Council of Canada, Forum Chairman.
Welcome by:
The Honourable Victor Schroeder, Minister of Industry, Trade and Technology, Province of Manitoba

0915 - 0945 Opening Address: "The Task of the Canadian Forum on a National Science and Technology Policy"
The Honourable Frank Oberle, Minister of State for Science and Technology, Canada

0945 - 1015 Bus transportation from the Fort Garry Hotel to the nearby Winnipeg Convention Centre; coffee, tea and juices available at the Centre, in or near the workshops.

At this point, the Forum will divide into six workshops, two on each of three themes. The workshops will be located on the main floor of the Convention Centre. Each workshop will have a resource person, a moderator, a rapporteur, and approximately 30 participants. Each participant will be assigned to workshops on all three themes and three workshops with simultaneous translation will be available in each of the three rounds, one workshop for each theme.

Workshop Topic A: "The Development and Acquisition of New Knowledge"

Workshop Topic B: "Putting Knowledge to Work and Realizing Opportunities"

Workshop Topic C: "Involving All Canadians and Adapting to Change"

1015 - 1200 First round of workshops.

1215 - 1345 Luncheon in Meeting Room #4 of the Winnipeg Convention Centre. The guest speaker will be the Honourable Howard Pawley, Premier of the Province of Manitoba.

1345 - 1530 Second round of workshops.

1530 - 1545 Break for coffee, tea and juices.

1545 - 1730 Third round of workshops.

1730 - 1800 Return bus service to the Fort Garry Hotel

1830 - 2100 Reception and dinner on the 7th floor of the Fort Garry Hotel, hosted by the Honourable Frank Oberle. The after dinner speaker will be Dr. J. Fraser Mustard.

10 June

0730 Written reports on the outcomes of the proceeding day's workshop sessions will be available for pickup at the Conference Secretariat desk on the 7th floor of the Fort Garry Hotel.

0900 - 1030 Plenary Session, in the 7th floor, Concert Hall, chaired by Dr. Stuart Smith, "A National Science and Technology Policy: A Look at Canada's Future".

There will be a fairly brief presentation of workshop findings, after which spokespersons from each of the sectors - university, industry and labour - will provide their comments.

1030 - 1045 Break for coffee, tea, and juices.

1045 - 1230 Plenary Session continues with further discussion of issues.

1230 - 1300 Summary statement by Dr. Stuart Smith. Closing remarks by the Honourable Frank Oberle.

Forum is adjourned

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CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Ordre du Jour définitif

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Winnipeg, du 8 au 10 juin 1986

ORDRE DU JOUR

Le 8 juin

15 h à 21 h	Inscription, hall de l'hôtel Fort Garry
19 h à 21 h	Réception offerte par les ministres fédéral, provinciaux et territoriaux à l'Institut canadien de technologie industrielle. Un autobus partira de l'hôtel Fort Garry.

Le 9 juin

8 h à 10 h	Inscription, 7e étage, hôtel Fort Garry
9 h à 9 h 15	Ouverture de la conférence : salle Concert Hall, 7e étage, hôtel Fort Garry M. Stuart Smith, Conseil des sciences du Canada, président de la conférence Mot de bienvenue : L'honorable Victor Schroeder, ministre de l'Industrie, du Commerce et de la Technologie du Manitoba
9 h 15 à 9 h 45	Allocution d'ouverture : "Le rôle de la Conférence nationale sur la politique scientifique et technologique" L'honorable Frank Oberle, ministre d'État, Sciences et Technologie Canada
9 h 45 à 10 h 15	Transport par autobus de l'hôtel Fort Garry au Centre de congrès de Winnipeg qui se trouve à proximité; du café, du thé et du jus seront servis Centre dans le secteur des salles d'ateliers.

La Conférence se divisera ensuite en six ateliers et chacun des trois thèmes sera étudié par deux ateliers. Les ateliers se réuniront au rez-de-chaussée du Centre des congrès et compteront chacun une personne ressource, un modérateur, un rapporteur et quelque 30 participants. Cette formule permettra à tous les participants de discuter des différents points de vue et de favoriser un consensus que le rapporteur présentera à la Conférence. Chaque participant pourra participer à des ateliers sur les trois thèmes. Un service d'interprétation simultanée sera fourni à trois ateliers portant sur des thèmes différents au cours de chacune des trois rondes.

Thème A : "Une politique nationale des sciences et de la technologie : Le développement et l'acquisition de nouvelles connaissances"

Thème B : "Une politique nationale des sciences et de la technologie : Faire servir les connaissances et profiter des occasions"

Thème C : Une politique nationale des sciences et de la technologie : Faire participer tous les Canadiens et s'adapter au changement"

10 h 15 à 12 h — Première ronde d'ateliers

12 h 15 à 13 h 45 — Déjeuner dans la salle de réunion n° 4 du Centre de congrès de Winnipeg. Le conférencier invité sera l'honorable Howard Pawley, Premier ministre du Manitoba.

13 h 45 à 15 h 30 — Deuxième ronde d'ateliers

15 h 30 à 15 h 45 — Pause café, thé et jus

15 h 45 à 17 h 30 — Troisième ronde d'ateliers

17 h 30 à 18 h — Retour à l'hôtel Fort Garry par autobus

18 h 30 à 21 h — Réception et dîner, au 7e étage de l'hôtel, Fort Garry, offerts par l'honorable Frank Oberle. Après le dîner le conférencier sera M. J. Fraser Mustard.

Le 10 juin

7 h 30	On pourra se procurer les rapports sur les travaux effectués la veille par les ateliers au bureau du Secrétariat des conférences situé au 7e étage de l'hôtel Fort Garry. Il y aura un rapport sur chacun des thèmes.
9 h à 10 h 30	Séance plénière présidée par M. Smith, salle Concert Hall au 7e étage, "Une politique nationale des sciences et la technologie : Regard sur l'avenir du Canada" Il y aura une brève présentation des conclusions des ateliers, après quoi des porte-parole de chacun des secteurs, soit des universités, de l'industrie et des syndicats, seront invités à faire des commentaires.
10 h 30 à 10 h 45	Pause café, thé et jus
10 h 45 à 12 h 30	Suite de la séance plénière et de l'étude des questions.
12 h 30 à 13 h	Résumé présenté par le président, M. Stuart Smith. Allocution de clôture prononcée par l'honorable Frank Oberle.

Fin de la conférence

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NATIONAL SCIENCE AND TECHNOLOGY FORUM

Notes on Meeting Arrangements

June 8-10, 1986
Winnipeg, Manitoba

Canadian Intergovernmental Conference Secretariat • Secrétariat des conférences intergouvernementales canadiennes

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NATIONAL SCIENCE AND TECHNOLOGY FORUM

June 8-10, 1986
Winnipeg

NOTES ON MEETING ARRANGEMENTS

1. Secretariat Services

a) Secretariat services will be available as follows:

~~June 8: 15:00 - 21:00 hours~~

June 9: 7:30 - 22:00 hours

June 10: 7:30 - 17:00 hours

b) The Secretariat will have a main office in the Loggia on the 7th floor of the Hotel Fort Garry to coordinate such services as typing, printing, distribution of documents, admission passes, handling of messages, interpretation and translation, etc. As well, there will be several toll-denied telephones in the secretariat for delegates use. To call long distance delegates should use a calling card or go through the operator.

During the workshops on June 9, a supplementary secretariat office will be set-up from 10:00 to 17:30 hours in room MR 17 at ~~the Winnipeg Convention Centre.~~

c) Delegates and observers are asked to have incoming telephone calls made on the Secretariat telephone number (204) 949-6956 in order to have messages taken and posted at the message board. Messages for Ministers will be delivered in person, if possible.

During the workshops on June 9, an additional number, (204) 949-6336, will be available for messages at the workshop site.

d) All requests for the above services should be addressed to the Conference Secretary, ERIC BURKLE, or the Secretariat Coordinators, CAROL BOURGEOIS and CATHY DERMODY. Secretariat services are available to all delegates. All support staff will wear badges with a black circle. Please ask them if you need any assistance.

2. Forum Documents

There is no access restriction to any of the forum documents. All documents are public unless otherwise requested by the originator.

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3. Document Distribution

a) During the Meeting

The CICS will provide a document distribution service during the meeting. In order to obtain this service, delegations should forward all requests to the Secretariat Office. No documents will be released without appropriate written authorization from the originator.

The CICS will also prepare and distribute a final list of delegates and observers and distribute same on Tuesday morning, June 10.

b) After the Meeting

After the meeting, the Secretariat will prepare a list of documents tabled. Copies of the listed documents will be available upon request.

4. Taped Record of Proceedings

The forum plenary sessions and the workshops will be taped. The taped record of these proceedings will be held by the Canadian Intergovernmental Conference Secretariat (CICS) and, with the approval of the Chairman, will be available on loan to delegations.

A verbatim transcript of the forum opening and plenary sessions will be prepared for the Science Council of Canada and the Ministry of State for Science and Technology. Copies will be available from the CICS on a request basis, subject to the approval of the Chairman.

5. Simultaneous Interpretation

Simultaneous interpretation in French and English will be provided for the plenary sessions in the Concert Hall at the hotel, and in rooms MR 5, MR 7/8, and MR 10/11 at the Convention Centre.

6. Access to the Meeting Rooms

The forum sessions will be open to invited delegates and observers and the media. Admission to the sessions will be controlled by the use of identification badges issued by the CICS. They should be worn at all times so as to facilitate access to the plenary sessions, workshops, receptions and meals.

7. Media Services

A media room will be available on the 7th floor of the Hotel Fort Garry and will be staffed by two media relations officers. The

telephone number for the media room is (204) 949-4166. The Secretariat can put you in touch with the media coordinators who will assist with arrangements for radio and television interviews and press conferences. Accredited media will have access to all forum sessions, including the workshops.

8. Transportation

Bus services will be available to and from the reception at the Science Centre on June 8 and to and from the Winnipeg Convention Centre on June 9. Details will be announced at the respective meetings.

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COLLOQUE NATIONAL SUR LES SCIENCES ET LA TECHNOLOGIE

Résumé de l'organisation matérielle

Du 8 au 10 juin 1986
Winnipeg (Manitoba)

Canadian Intergovernmental Conference Secretariat • Secretariat des conferences intergouvernementales canadiennes

VEUILLEZ NOTER

COLLOQUE NATIONAL SUR LES SCIENCES ET LA TECHNOLOGIE

Du 8 au 10 juin 1986
Winnipeg

RÉSUMÉ DE L'ORGANISATION MATÉRIELLE

1. Services du Secrétariat

a) Les services du Secrétariat seront disponibles :

le 8 juin : de 15 h à 21 h

le 9 juin : de 7 h 30 à 22 h

le 10 juin : de 7 h 30 à 17 h

b) Le bureau principal du Secrétariat sera situé à la Loggia, au 7[e] étage de l'hôtel Fort Garry, et il se chargera de coordonner les services de transcription, d'impression et de distribution des documents, les laissez-passer, l'acheminement des messages, l'interprétation et la traduction, etc. On y trouvera également quelques appareils téléphoniques sans accès à l'interurbain. Pour appeler à l'extérieur de la ville, les délégués sont priés d'utiliser un code d'appel ou de s'adresser à la téléphoniste.

Durant les ateliers le 9 juin, le Secrétariat aura également un bureau de 10 h à 17 h 30 à la salle MR 17 du Centre des congrès de Winnipeg.

c) Les délégués sont priés de faire acheminer leurs appels au numéro de téléphone du Secrétariat ((204) 949-6956) afin que celui-ci puisse prendre les messages et les afficher au tableau. Si possible, les messages destinés aux ministres leur seront remis personnellement.

Durant les ateliers, les messages pourront également être pris au (204) 949-6336, là où se tiendront les ateliers.

d) Toute demande relative aux services susmentionnés doit être transmise au secrétaire de la conférence, ERIC BURKLE, ou aux coordonnateurs du Secrétariat, CAROL BOURGEOIS et CATHY DERMODY. Les services du Secrétariat sont offerts à tous les délégués. Le personnel portera des laissez-passer marqués d'un cercle noir, et sera à votre disposition si vous avez besoin d'aide.

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2. Documents du colloque

L'accès aux documents du colloque ne sera soumis à aucune restriction. Tous les documents seront publics à moins d'indications contraires de la personne ayant déposé le document.

3. Distribution des documents

a) Pendant la conférence

Le SCIC offrira un service de distribution des documents pendant la conférence. Pour obtenir ce service, les délégations doivent envoyer toutes les demandes au bureau du Secrétariat. Aucun document ne sera diffusé sans une autorisation appropriée de la personne ayant déposé le document.

Le SCIC dressera en outre la liste définitive des délégués et observateurs, et la distribuera le mardi 10 juin en matinée.

b) Après la conférence

Après la conférence, le Secrétariat dressera la liste des documents qui y auront été présentés. Les personnes qui en feront la demande pourront obtenir des copies des documents figurant sur la liste.

4. Enregistrement des délibérations

Les séances plénières du colloque et les ateliers seront enregistrés. Le Secrétariat des conférences intergouvernementales canadiennes (SCIC) gardera l'enregistrement des délibérations qui, avec l'autorisation du président, pourra être prêté aux délégations.

Un compte rendu textuel de la séance d'ouverture et des séances plénières du colloque sera rédigé à l'intention du Conseil des sciences du Canada et du ministère d'État chargé des Sciences et de la Technologie. Le SCIC, sous réserve de l'approbation du président, en fournira des copies à ceux qui en feront la demande.

5. Interprétation simultanée

Un service d'interprétation simultanée vers le français et vers l'anglais sera offert dans la salle de concert de l'hôtel pour les séances plénières, et dans les salles MR 5, MR 7/8 et MR 10/11 du Centre des congrès.

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6. Accès aux salles de réunion

Les délégués et observateurs invités ainsi que la presse seront admis aux séances du colloque. L'accès aux salles sera contrôlé au moyen de laissez-passer que remettra le SCIC. Prière de les porter en tout temps afin de faciliter l'accès aux séances plénières, aux ateliers, aux réceptions et aux repas.

7. Services à la presse

Une salle de presse sera aménagée au 7e étage de l'hôtel Fort Garry, et deux agents de relations avec la presse y seront affectés. Le numéro de téléphone de la salle de presse sera (204) 949-4166. Le Secrétariat pourra vous mettre en contact avec les coordonnateurs de presse qui vous aideront à prendre les dispositions voulues pour les entrevues à la radio et à la télévision et pour les conférences de presse.

8. Transport

Un service d'autobus sera offert à l'aller et au retour pour la réception du 8 juin au Science Centre, et à l'aller et au retour pour les séances du 9 juin au Centre des congrès de Winnipeg. Les détails seront communiqués lors des rencontres respectives.

Adresse postale:
C.P. 488
Succursale 'A'
Ottawa (Ontario)
K1N 8V5

Adress du bureau:
110, rue O'Connor
Ottawa (Ontario)

Bélinographe (613) 996-6091
Télex 053-4435
Numéro de téléphone: 995-2341

830-220/003

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Final List of Delegates and Observers

Liste finale des délégués et observateurs

June 8-10, 1986
Winnipeg, Manitoba

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

CONFÉRENCE NATIONALE SUR LA POLITIQUE
SCIENTIFIQUE ET TECHNOLOGIQUE

June 9 & 10, 1986 Les 9 et 10 juin 1986

WINNIPEG

Final List of Delegates & Observers
Liste finale des délégués et observateurs

Stuart L. Smith
Chairman
Science Council of Canada

The Hon. Frank H. Oberle
Minister of State
Science and Technology
Government of Canada

The Hon. Fernand G. Dubé
Minister of Commerce and Technology
Government of New Brunswick

The Hon. Vic Schroeder
Minister of Industry, Trade and Technology
Government of Manitoba

The Hon. Hal Barrett
Minister of Development and Tourism
Government of Newfoundland

The Hon. Hugh O'Neil
Minister of Industry, Trade and Technology
Government of Ontario

The Hon. Tony Penikett
House Leader
Government of Yukon

David Berger, M.P.
Standing Committee on Research, Science and Technology
House of Commons

David Daubney, M.P.
Standing Committee on Research, Science and Technology
House of Commons

Joan Dougherty, députée
Secrétaire parlementaire de Monsieur Claude Ryan
Ministère de l'Enseignement supérieur et de la Science
Gouvernement du Québec

Suzanne Duplessis, députée
Comité permanent de la recherche, de la science et de la technologie
Chambre des communes

Claude Lanthier, député
Secrétaire parlementaire de l'honorable Frank Oberle
Chambre des communes

Guy Ricard, député
Secrétaire parlementaire
Comité permanent de la recherche, de la science et de la technologie
Chambre des communes

Guy Rivard, député
Secrétaire parlementaire de Monsieur Pierre MacDonald
Ministère du Commerce extérieur et du Développement technologique
Gouvernement du Québec

Bill Tupper, M.P.
Chairman of Standing Committee on Research, Science and Technology
House of Commons

Mark Abbott
Science and Technology Committee
Canadian Manufacturers Association/Association des manufacturiers canadiens
Vice-President
Polysar Limited

W. Peter Adams
Executive Director
Association of Canadian Universities for Northern Studies/
Association universitaire canadienne d'études nordiques
Professor
Department of Geography
Trent University

Robert Alden
Vice-Chairman
Institute of Electrical and Electronics Engineers
Professor
Department of Electrical Engineering
MacMaster University

Ed Anderson
University of Manitoba
Canadian Association of University Teachers

Trevor M. Apperley
Director
Corporate and Investor Relations
Develcon Electronics Ltd.

Dan Archer
Technology Division
Ministry of Industry, Trade and Technology
Government of Manitoba

Margaret-Ann Armour
President
WISEST
Department of Chemistry
University of Alberta

Larry S. Armstrong
Deputy Minister
Department of Commerce and Technology
Government of New Brunswick

Norman L. Arrison
President
Alberta Laser Institute
and Member, Science Council of Canada

Donald F. Arseneau
Professor of Chemistry
Director, Bras D'Or Institute
and Member, Science Council of Canada

Alan Artibise
President-elect
Social Science Federation of Canada/Fédération
canadienne des sciences sociales
Director
Institute of Urban Studies
University of Winnipeg

Don Assaff
Vice-President, Research Policy
Corporate-Higher Education Forum
Director of University Liaison
Bell Canada

Alan Astbury
Professor of Physics
University of Victoria

Susan Attenborough
National Representative
Canadian Labour Congress

Morrel P. Bachynski
President
MPB Technologies Inc.
and Member, Science Council of Canada

Guy Bertrand
President
Centre de recherche industrielle du Québec

Alec Bishop
Vice-President
Aerospace Industries Association of Canada/Association des
industries aerospaciales du Canada

Cam Blachford
Associate Vice-President
Research and Graduate Studies
University of Regina

Roger Blais
Directeur
Services de R-D coopératifs
École Polytechnique

Louis-Philippe Blanchard
Recteur
Université de Moncton

Tom Bleasdale
National Union of Provincial Government Employees

Bert Blevis
Executive Director, Research
Telecommunications and Informatics
Department of Communications
Government of Canada

John Bracken
Chief of Staff
Office of the Honourable Frank Oberle

M.L. (Buddy) Brownstone
Director of Operations
Gemini Outerwear Ltd.

Ralph Bullock
Vice-President
Engineering
Bristol Aerospace Ltd.

Thomas C. Burnett
Chairman of R&D Committee
The Canadian Chamber of Commerce/La chambre du commerce du Canada
Manager, Process Sales Inco. Ltd.

Michael D.B. Burt
Chairman
Department of Biology
University of New Brunswick
and Member, Science Council of Canada

Winslow Case
Division of Science and Engineering Technology
Cambrian College
and Member, Science Council of Canada

Vera Chernecki
President
Manitoba Organization of
Nurses Associations

Alan Cobb
Director General
University Research and Granting Councils
Ministry of State for Science and Technology

Art Collin
Secretary and Chief Science Advisor
Ministry of State for Science and Technology

David Conklin
Research Coordinator
Institute for Research on Public Policy

Brian Corcoran
Group Chief
Program Branch
Treasury Board Secretariat

Alan Cornford
Assistant Deputy Minister
Ministry of International Trade, Science and Technology
Government of British Columbia

Pierre Coulombe
Directeur
Innovation technologique
Ministère du Commerce extérieur et du Développement technologique
Gouvernement du Québec

James Cutt
Director
School of Public Administration
University of Victoria
and Member, Science Council of Canada

Leo Derikx
Director
Planning and Budgeting
Natural Sciences and Engineering Research Council of Canada

Graham Dixon
Public Affairs Advisor for Manitoba
Canadian Bankers Association/Association de banquiers canadien

Denzil J. Doyle
President
Doyletech Corporation

E. Lawson Drake
Dean of Science
University of Prince Edward Island

François Duchesneau
Président
Fédération canadienne des études humaine/Fédération canadienne des études humaines
Directeur
Département de philosophie
Université de Montréal

J. Regis Duffy
President
Diagnostic Chemicals Ltd.

Yvon C. Dupuis
President
Canadian Council of Professional Engineers/Conseil canadien des ingénieurs
President
Consultants Dutech Inc.

Gerry Dyer
Chairman
R&D Committee
Canadian Chemical Producers' Association/Association canadienne des fabricants de produits chimiques
Manager Research Division
DuPont Canada Inc.

Louis Erlichman
General Vice-President
International Association of Machinists and Aerospace Workers

John Evans
Chairman and Chief Executive Officer
Allelix Inc.

Christine Fisher
Clerk of the Standing Committee on Research, Science and Technology
House of Commons

William G. Forbes
Past President
Association of Canadian Community Colleges/Association des colleges communautaires canadien
President
Westerra Institute of Technology

Chantal Fortier
Vice-Présidente
Association des communicateurs scientifiques du Québec

William Forward
Policy Analyst
Industrial and Science Policy Group
Economic Programs and Government Finance Branch
Department of Finance

Robert Fournier
Assistant Vice-President
Research
Dalhousie University

Henry G. Friesen
Member
Medical Research Council of Canada
Chairman
Department of Physiology
University of Manitoba

Sheldon Fulton
President
Homestead Computer Services Ltd.

Jean-Pierre Garant
Professeur
Faculté d'administration
Université de Sherbrooke
et Membre, Conseil des sciences du Canada

Clément Gauthier
President
The National Consortium of Scientific and Educational Societies/ Le Consortium national des sociétés scientifiques et pédagogiques
University of Ottawa
Faculty of Health Services

Hank Gauthier
National Administrative Assistant
Energy and Chemical Workers' Union of Alberta

Eric Geddes
Chairman
Alberta Heritage Foundation for Medical Research
Senior Partner
Price Waterhouse

Don George
Dean of Applied Science
Simon Fraser University

J. Clay Gilson
Professor
Department of Agricultural Economics and Farm Management
University of Manitoba
and Member, Science Council of Canada

Greg Gould
United Automobile, Aerospace and Agricultural Implement
Workers of America

George Greenland
Assistant Deputy Minister
Department of Development and Tourism
Government of Newfoundland

Jacques Guigné
Group Leader, Marine Geophysics
Centre for Cold Ocean Resources Engineering

Alex Guy
Deputy Minister
Department of Science and Technology
Government of Saskatchewan

Camil Guy
Directeur
Direction de la maîtrise du développement scientifique
et technologique
Ministère de l'Enseignement supérieur et de la science
Gouvernement du Québec

Robin Haighton
Manager, Business Development
Canadian Standards Association

Lyn Harrington
Office of the Honourable Hugh O'Neil

Terry Hogan
Councillor
Social Science and Humanities Research Council

John B. Hood
President
Canadian Council of Technicians and Technologists/
Conseil canadien des techniciens et technologiques
Professor
Civil Engineering Department
Cambrian College

Cy Howard
Vice-President, South Winnipeg Technical Centre
Association of Canadian Community Colleges

Terry E. Howard
Executive Director
British Columbia Research

Wilf Hudson
President
Manitoba Federation of Labour

Graeme Hughes
President
Business Equipment Manufacturers Association of Canada/
Association canadienne des fabricants d'équipement du bureau

Ronald Humble
Senior Policy Advisor
Industry, Trade and Technology
Government of Manitoba

Reg Humphreys
Chairman
Alberta Oil Sands Technology and Research Authority

Nadeen Hunt
President
Saskatchewan Federation of Labour

Seaford O. Jack
Director, Executive Committee
Canadian Council of Technicians and Technologists/
Conseil canadien des techniciens et technologiques
Project Manager, James Richardson and Sons

Robert Janes
Executive Director
Science Institute of the Northwest Territories

Gilles Jasmin
Chief
Educational Statistics
Department of the Secretary of State of Canada

Jay Janes
Co-ordinator
Manitoba Dialogue on Technology
Industry, Trade & Technology

J. Gordin Kaplan
Vice-President (Research)
University of Alberta

Margaret Kende
Co-chairperson
CAFWEST
Dean of Engineering
Centennial College

Geraldine A. Kenney-Wallace
Professor of Chemistry and Physics
Lash Miller Laboratories
University of Toronto
and Member, Science Council of Canada

Dermot Kingston
New Brunswick Federation of Labour

Tim Koepke
Underhill Engineering Ltd.

Art Kube
President
British Columbia Federation of Labour

Maurice L'Abbé
Président
Conseil de la science et de la technologie du Québec

Guy Laberge
President
Lavalin Tech. Inc.

Fernand Labrie
Directeur
Centre de recherches en endocrinologie moléculaire
Université Laval
et Membre, Conseil des sciences du Canada

Michel Lagacé
Association canadienne-française pour l'avancement
des sciences

Pierre Lampron
Directeur général
Direction générale des politiques
Ministère des Communications
Gouvernement du Québec

Peter Larkin
Vice President of Research
Office of the President
University of British Columbia

Bernard M. Leduc
Professeur agrégé
Faculté de médecine
Université de Montréal
et Membre, Conseil des sciences du Canada

Mart Leesti
Acting Commissioner of Patents
Department of Consumer and Corporate Affairs

Richard A. Letilley
Executive Director
Department of Science and Technology
Government of Saskatchewan

Guy Létourneau
Sous-ministre adjoint à la science
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Final List of Delegates and Observers

Liste finale des délégués et observateurs

June 8-10, 1986
Winnipeg, Manitoba

du 8 au 10 juin 1986
Winnipeg (Manitoba)

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Towards a Cultural Base for a Science and Technology Policy

Association for Advancement of Science in Canada

June 8-10, 1986
Winnipeg, Manitoba

PRÉCIS

Les caractéristiques géographiques de notre pays, à elles seules, font que la société canadienne utilise largement les applications des sciences et de la technologie. Il est donc naturel que notre héritage scientifique et technologique soit abondant; mais peu de Canadiens s'en rendent compte.

Les membres de la collectivité canadienne sont de grands acheteurs de produits sophistiqués, sans cependant se préoccuper d'équilibrer la balance commerciale du pays en développant, en fabriquant et en vendant de tels produits. La clientèle électorale instruite accepte ce déséquilibre financier parce qu'elle est encore convaincue qu'on peut toujours y remédier en exportant plus de ressources naturelles. Tant que cet état d'esprit prévaudra, on ne disposera pas de bases solides pour l'élaboration d'une Politique nationale efficace des sciences, comme les difficultés rencontrées par un effort similaire au cours des vingt dernières années l'ont bien montré.

Nous estimons que ces difficultés persisteront jusqu'à ce que le grand public intègre les sciences et la technologie dans sa culture et abandonne sa conception d'une société basée sur l'exploitation des ressources naturelles, comme naguère, pour celle, plus actuelle, d'une société fondée sur les connaissances, et exigeant un soutien substantiel à l'effort de recherche et de développement technique. A long terme, peut-être au cours des deux décennies qui viennent, la mise en oeuvre des recommandations récentes du Conseil des sciences en matière d'éducation améliorera-t-elle la situation. Mais, en attendant, il nous faut aussi remédier aux problèmes à court terme.

En nous basant sur les considérations qui précèdent, nous proposons aux participants à la Conférence de Winnipeg d'envisager deux voies d'action parallèles. Outre la recherche d'un consensus sur la façon d'élaborer la Politique des sciences du Canada,

les participants devraient débattre les moyens les plus efficaces pour exposer au public canadien l'importance de la S-T dans leur existence, et donc la nécessité d'une politique des sciences et de la technologie.

Nous avons conclu que, parmi les nombreuses approches possibles, deux méthodes offraient des perspectives de succès à courte échéance. La première consisterait à créer une grande association bénévole publiant sa propre revue (par exemple Equinox pour la collectivité anglophone). L'autre serait de rassembler dans un effort de coopération, par le truchement du Musée national des sciences et de la technologie, des bonnes volontés venant de l'industrie, des universités et du secteur public, qui exposeraient au public quelles sont leurs réalisations communes dans tous les domaines des sciences et de la technologie, tout comme on le fait actuellement pour les communications et l'espace.

Le succès de ces deux initiatives serait facilité par l'encouragement et le soutien des participants à la présente Conférence.

EXECUTIVE SUMMARY

Our geography is enough to make Canadian society particularly dependent on applications of science and technology. It is natural, therefore, that our scientific and technological heritage should be rich - a fact few Canadians appreciate.

We in Canada are a society of high spenders on technological products without balancing the books through earnings from the development, production and sale of such products. Our well educated electorate accepts the above imbalance because it has been convinced that we can always balance the books by exporting natural resources. As long as this mindset prevails, there is little basis for an effective national science policy, as has been demonstrated by the difficulties met over the past twenty years in establishing such a policy.

We believe that these difficulties will persist until the public at large embraces science and technology as part of its culture and makes a conceptual transition from the resource-based society of yesterday to a knowledge-based society of today, demanding substantial support for research and development. Over the long term, perhaps over two decades, the implementation of the recommendations in the recent report by the Science Council of Canada on Science Education may change things for the better. But we must also tackle the problem in the short-term.

Recognizing the above, we encourage the Winnipeg Forum to consider two parallel streams of action. In addition to seeking consensus on how to fashion the most appropriate science and technology policy for Canada, the Forum should consider appropriate means for explaining to the Canadian public the importance of S & T in their lives and hence the very need for a science and technology policy.

We have proposed that among the many approaches, two offer the best prospect for success in the near future. One is the development of a large national voluntary association (AASC) with its own magazine (in the first instance Equinox for the English community).The other is to bring together, through the National Museum of Science and Technology, in a cooperative effort, participants from industry, universities and government to tell the story of their common achievements, in all fields of science and technology, just as it is being done for Communications and Space.

Encouragement and support from the participants in this Forum can speed the success of these two initiatives.

TOWARDS A CULTURAL BASE FOR A SCIENCE AND TECHNOLOGY POLICY

A Brief for the Canadian Forum on
A National Science and Technology Policy
submitted by

THE ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE IN CANADA

Presented by: J. Wm McGowan, President, AASC
Director, NMST

Ottawa, 24 May 1986

TOWARDS A CULTURAL BASE FOR A SCIENCE AND TECHNOLOGY POLICY

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1. THE CONUNDRUM OF THE SCIENCE AND TECHNOLOGY POLICY

The need for a science and technology policy, with appropriate mechanisms for its development in the post World War II environment, has been recognized and discussed since the early sixties. The development mechanisms at the federal level have been in place since 1964. After two decades of good will and much investment on the part of the federal government and several provincial governments, why has there not been more progress? Why do we not have an effective science policy already in place?

There are, of course, many reasons, but we shall discuss in this brief what we regard as the underlying problem which must be addressed if more direct policy actions are to lead to sustained progress. We believe that, as Canadians, we have been unable to effectively communicate the importance of science and technology for the development of our country to either the general public or our national leaders, consequently making it virtually impossible for our political leaders to lead in this field.

1.1 Do we Need Science and Technology?

The most fundamental question for the national science and technology policy may be this: Is there a need for science and technology-intensive economy in Canada? One can confidently predict that all those present at the Winnipeg Forum will answer "yes". Yet the majority of the voters in general, and the economic activists in particular, clearly have not thought so to date. Many believe that the calls for intensive R & D and a high rate of domestic innovation reflect only vested interests or should be dismissed as voices of the "S & T fanatics" who will not change for the sake of change. These beliefs have to be reversed before a science policy can be agreed upon and implemented.

One must admit that a low-intensity S & T economy is a feasible option. Even now, society can choose such a life style and be happy with it. The Mennonites are an example. All one needs are modest expectations, a low density of population and benevolent neighbours. But the fact is that apart from the Mennonites and a few others, Canadians have not chosen a low-technology lifestyle. On the contrary, statistics clearly show that Canadians embrace high technology with open houses and open purses. Unfortunately, they are reticent to embrace the same technology as the engine of economic growth through domestic innovation.

We are a society of high spenders on technological products without balancing the books through earnings from the development, production and sale of such products. This imbalance is the end result of thousands of political decisions, financial investments and career choices. Most of these decisions are made directly by individual citizens, but many are made on their behalf by political and business leaders, acting on the basis of prevailing attitudes within the society.

How can it be that our well educated electorate accepts the above imbalance in a major sector of the economy? It is simply because it has been told that our strength is elsewhere. Examples from the past, amplified by exhortations from many among the most influential leaders, have convinced the voters that we should avoid the high risk of competing in the high technology market, because we can always balance the books by exporting natural resources. Yet, few recognize that the copper we use to carry signals across our vast land is being replaced by glass fibers and the iron we use in our cars will soon be replaced by plastics, composite materials and ceramics, all products of research and development.

As long as this mindset prevails, there is little basis for an effective national science policy. The converted will go on talking to themselves and even high-level policy announcements will turn out to be examples of wishful thinking rather than milestones of progress.

The evidence of the world economy clearly shows an apparent paradox: countries well endowed with national resources are generally not doing as well as those which must import raw materials and rely on exports of upgraded products. There are exceptions, of course, but that is what they are: limited exceptions. Even in the case of oil, what worked well for the low density population of Saudi-Arabia, has not worked for the more densely populated Mexico.

The basic explanation of the paradox, though simple, is not well understood by Canadians. The raw resources are, by their nature, limited in variety. One cannot usually create a new demand for lumber by sawing logs in a different way: there are only a few ways to do so and the competitors know them all. Thus, when a glut occurs on the market, there is little defence. If the competitors have lower costs or are subsidized, you lose sales or sell at a loss, starving either way.

The higher up one goes on the scale of product sophistication, the greater the variety of possible products. If you cannot compete with a given product, you can always switch to another one. If you can innovate, you can be ahead of competition, opening up new markets. You are still limited by your own ingenuity, but you are at least a master of your destiny. Assured domestic supplies of raw materials then become a source of additional strength even though natural resources are less in demand today than yesterday. Furthermore, high technology and inventiveness can, of course, be applied to reduce the cost and to improve the quality of the "raw" materials, well beyond the limits of traditional processes.

1.2 A Precondition to the Development of a S & T Policy

The above arguments are all well known to the politicians and officials in charge of technological departments, but again they are not well known and/or accepted by many others who influence the scope of action of these departments, be they other politicians and officials, or the general public. Also, an effective implementation of science policy involves the nation at large. Thus, an understanding of the role of science and technology in our society by all Canadians is a precondition for both the formulation and the successful implementation of the national science policy. In other words: a government can only put in place a strong, purposeful science and technology policy when the voters understand the issues the policy is concerned with.

2. COPING WITH CULTURAL CHALLENGE

2.1 Some Federal Approaches

The foregoing demonstrates the need to bring science and technology from the periphery into the mainstream of the Canadian culture. The development and appropriate use of science and technology must become a matter of priority rather than a redundant or a feared option.

Governments recognized the need for a cultural basis for a science and technology policy many years ago. The first explicit manifestation at the federal level occurred in 1968 when the Science Council of Canada Act was amended to give it the freedom to publish its findings. This was followed by another amendment in 1978 which made it a function of the Council:

"to increase public awareness of

i) scientific and technological problems and opportunities, and

ii) the interdependence of the public, governments, industries and universities in the development and use of science and technology"

Unfortunately, this new mandate was never supported by significant new resources. The freedom with which the Science Council of Canada can involve in its work individuals, groups, institutions and firms from both outside and inside the government ("the networking"), combined with its publishing activities, helps to spread interest in the issues of science and technology policy.

However, a small governmental organization for policy analysis and development cannot (and should not) reach the mass-public by direct means. Its message has to be picked up and amplified by other instruments for large-scale communications. This has not been happening on a scale commensurable with the need.

More recently, the Ministry of State for Science and Technology established the Public Awareness Program. This program gives relatively small grants in support of public awareness activities (related to STS issues) carried out primarily by non-profit organizations, publishers and film and television producers. The program is useful but, with an annual disbursement budget of about $1 million, thinly distributed among scores of applicants, it cannot by itself have a major influence on national attitudes.

2.2. Agents of Mass Influence

Leaving apart the education system, the churches and the government information programs, the principal agents of mass influence are:

1. Mass media (commercial and public)
   Television, Radio, Newspapers, Magazines
2. Special Instruments
   Museums, Exhibitions and Expositions
3. Large Voluntary Organizations
   Professional Associations, Common Interest Groups
4. National Leaders (through public statements)
   Ministers, Members of Parliament and Legislatures, industrial and academic personalities.

The typical sizes of populations reached directly through these means are illustrated in the Table and discussed in Appendix A. Naturally, the impact of the various types of exposures is not the same, hence direct numerical comparisons need careful interpretation. Nevertheless, the gross picture is instructive. The performance of these agents in Canada with respect to S & T issues is reviewed (subjectively, we admit) in the Appendix A. The general conclusion is that none of the principal agents of mass influence gives enough attention to the S & T issues, or does it effectively enough to induce an attitudinal change. The dearth of positive influence by the mass media and the national leaders is particularly important because of their dual influence: while not addressing the S & T issues, they reinforce each other in attracting attention to other topics, thus making it more difficult for the other agents to exercise corrective influence.

TABLE TYPICAL OR POTENTIAL AUDIENCES REACHED BY AGENTS OF MASS INFLUENCE IN CANADA

MASS MEDIA	millions
Television	
The Nature of Things (CBC) David Suzuki	1.3 / program
A Planet for the Taking (CBC) David Suzuki	1.5 / program
Radio	
Quirks and Quarks (CBC) Jay Ingram	0.3 / program
Ideas Series (CBC) Lister Sinclair	0.25 / program
Newspapers (total circulation)	
Globe & Mail	0.32 / daily
Montreal Gazette	0.2 / daily
La Presse	0.25 / daily
Vancouver Sun	0.26 / daily
Magazines (total circulation)	
MacLeans	0.65 / weekly
Equinox	0.17 /bi-monthly
Quebec Science	0.03 / monthly
Canadian Geographic	0.125/ monthly
SPECIAL INSTRUMENTS	
Museums (annual attendance)	
National Museum of Science & Technology	0.8
British Columbia Provincial Museum	1.26
London Children's Museum	0.1
Manitoba Museum of Man and Nature	0.26
Museum Planetarium	0.11

SPECIAL INSTRUMENTS (cont'd)

Science Centres (annual attendance)	
Ontario Science Centre	1.1
Science North	0.5
Edmonton Space Science Centre	0.4
Arts, Sciences and Technology Centre - Vancouver	0.28
Exhibitions	
Expo 67 (over the duration)	51.0
Expo 86 (estimated)	20.0

LARGE VOLUNTARY ORGANIZATIONS (devoted to STS issues)

Association for the Advancement of Science in Canada (when combined with *Equinox*)	0.17

NATIONAL LEADERS

Statements by: Prime Minister and other national leaders demanding full weight of the media	15.0

In the absence of some form of intervention, the situation is a "vicious circle". The media, for example, do not give more attention to the S & T because of their perception that there is not enough public interest in the subject (except in the case of a disaster). The public, in turn, can hardly develop much interest when its attention is being directed elsewhere. Similar blockages exist with respect to the other agents. The national leaders are asked, most often about issues which are already topical. This, by itself, maintains their topicality.

Currently, there is no voluntary association devoted solely to the relationship between science, technology and society (the "STS" issues) that is large enough to either attract attention of the media or to reach a substantial public through its own publication, and thus to grow above the critical size for exerting influence.

Neither have our cultural institutions (e.g. museums, science centres) reached the stage of sophistication where they effectively present STS issues as part of their regular exhibitry. The very popularity of the current exhibitry works against the needed evolution.

How can we break these vicious circles?

3. INVOLVING THE PUBLIC

In the long term, the sensitization of the Canadian public will occur through the formal education system. The treatment of science and technology in the school system has been analysed thoroughly during the recent study of science education, undertaken by the Science Council of Canada in cooperation with the provincial departments of education and their school systems.*

* See Science for Every Student: Educating Canadians for Tomorrow's World Science Council of Canada, Report 36, April 1984.

There are already firm indications that this study will have a profound, positive impact on the provincial school systems. The future curricula should prevent the now all-too-common estrangement from science among all students except the prospective scientists. However, the results of this change will be felt only a generation from now.

3.1 General Requirements

There is much more that needs to be done now. In particular, one has to reach those already out of the school system while supporting the new programs within the schools. The task of influencing the perception of science and technology by millions of Canadians is enormous. Learning from past experience, we believe that:

1) Purely governmental programs which are designed to influence the public are questionable. They are inherently expensive, and seldom effective.

2) Cooperative programs bringing together both private and public groups are needed.

3) These require strong committed leadership who will be sensitive to the value of networking.

4) A large audience demanding more information about science, technology and society issues must be developed and be clearly visible.

5) A concerted effort must be made by the leaders to win the support of publishers, producers and editors.

6) New initiatives should build upon existing mechanisms, and

7) Programs designed to reach the anglophone community must be initiated since the francophone community is already better served by several magazines and the media (see Appendix A).

3.2 A Strategy

It is important that we devise a scheme whereby mitigating factors which prevent development of interest in science, technology and society issues be replaced by positive reinforcement. This is the only way one can possibly achieve large scale influence without developing costly government-sponsored P.R. programs which would not likely be acceptable to the public.

The expanding spiral of positive reinforcement must therefore be triggered by willing agents, acting from conviction. The media and national leaders have not been willing enough so far. This leaves the voluntary sector and the special cultural instruments to pick up the challenge.

In the voluntary sector, the Association for the Advancement of Science in Canada (AASC) / l'Association pour l'avancement des sciences au Canada (AASC), on whose behalf this brief is presented, has a single objective, which is, as taken from the constitution:

> "To foster understanding of the significance of science, technology and engineering to Canadian society".

This objective springs from recognition of the cultural problems discussed above. The Association was established in 1982 to address this very problem. It is the only association which addresses it as its sole concern, but has been cooperating with many other voluntary organizations which address it as a part of their mandate.

Among the special cultural instruments, the National Museum of Science and Technology has been pioneering the idea of expanding the exhibitry from presenting the nature and history of science and technology to encompass presentation of their impact on society. Furthermore, the Association and the Museum are anxious to reinforce their efforts through cooperation.

It is our belief that these organizations working in concert will be able to attract the attention of the media and national leaders and will thus succeed in initiating positive reinforcement of the public awareness process.

4. AGENTS OF CHANGE

4.1 A Major Voluntary Association with a Dedicated Magazine

The objectives of AASC are matched by its structure which is based on individual membership comprised of both the lay public and the S & T practitioners, on equal terms. The size of this membership is currently too small. To be fully effective, the membership should exceed 100,000 (towards a long-term goal of over 1 million). The association will then have a strong financial base drawn from membership fees. This will permit long-term planning of both national and community-based activities. Such activities will in turn permit it to cooperate constructively in a leading role with many existing groups working in the same field.

There are good reasons for not regarding the above target as an impossible dream. Already sister organizations prosper in other countries, e.g., U.S.A., Britain, Brazil and India, with but one difference: they serve primarily a professional community. Fortuitous rather than fundamental reasons have prevented the development of such a society so far in Canada.

To achieve rapid expansion, the membership of the Association must be served by a mass circulation magazine focussing on science and technology in Canada. A unique opportunity to meet this need exists right now. The magazine Equinox (circulation near 170,000) already has much coverage of the sciences. Its publisher is exploring with AASC the possibility of an affiliation through a joint subscription / membership scheme. In addition to a more extensive future coverage of the STS issues, the magazine would include an insert devoted to association news. Furthermore, the magazine would produce for members an annual review of scientific and technological issues and activities in Canada. Developed by AASC, such a review would thus receive a much wider distribution than could ever be expected for a departmental publication or a science policy journal. This review would be published in both official languages. In general, the question of how to serve the francophone population will be addressed more fully in discussions with the Association canadienne-française pour l'avancement des sciences (ACFAS - see Appendix A).

The unique feature of the above plan is the union of a voluntary organization with a high quality commercial magazine. Assuming that the affiliation of AASC and Equinox is successfully achieved, the organization will have:

- Membership combining experts and non-experts, thus breaking the traditional separation, where converted talk only to the converted while the uninformed consult with other uninformed.
- Over 100,000 members.
- Financial independence.
- Means for undertaking projects which would attract participation by leaders concerned with the STS issues.
- Strong links with the organized scientific and engineering community opening up access to expertise in all areas of natural, physical and social sciences (see Appendix B for the list of institutional members already affiliated with AASC).
- Potential for cooperative projects on STS issues with the technical and non technical associations - e.g., public discussions of some such issues on the occasion of annual meetings of professional associations (e.g. educators, lawyers, architects, physicists),industrial associations (e.g. manufacturers), or public interest groups (e.g. consumers).
- Cooperation with the media in setting up bear-pit or open line programs, etc.
- Setting up of forums to discuss new developments in science policy or the need for such developments.
- Use of international links with sister associations to compare attitudes to STS issues.
- Interaction with Parliamentarians through the Committee of Parliamentarians, Scientists and Engineers (COPSE).
- And many other possibilities.

4.2 A Cooperative Approach to a Science and Technology Museum

There exists but one National Museum of Science and Technology (NMST, with its headquarters in Ottawa) having an explicit objective to change the attitude of the nation with regard to S & T. Complementing its activities are those of a number of provincial and regional Museums and Science Centres committed to one aspect or another of this objective. Many of these institutions are already tied formally to NMST through the Canadian Council of Science Centres. Already, major exhibits are being exchanged between many of these institutions.

As part of its long-term planning, NMST is developing Theme Museums like Aviation, Agriculture and Communications and Space which bring together various industries and departments of government in a cooperative effort to address one part or another of the Canadian story. Support for these cooperative efforts will be shared by different levels of government and by private industry.

It is expected that major exhibits, plays, T.V. specials, books, radio productions, and traveling exhibits describing Canada's S & T efforts and discussing their impact on the lives of Canadians will be prepared through cooperative efforts and shared with other institutions and the media.

The power of the proposed new cooperative approach to museum development will be great. Through it one can expect that,

- Millions of Canadians will learn more about the impact of Canadian technology and science in Canadian lives.
- Industries and government departments will be able to be equal partners in story development.
- An institution will be formed which can focus not only on past problems but, through the industrial contacts, on problems of today and in the future.
- A complete Canadian story is more likely to be told.
- The museum will serve as a forum for dialogue on the impact of S & T on Canadians.

- Various industries and government departments will have a show case where they can share their particular stories with others.
- Small financial contributions from many groups will make possible the development of major exhibits, T.V. specials, etc.
- Many groups will be full partners in the museum.
- Through the cooperative effort, Canada will be able to afford one of the world's leading institutions.

As part of the effort to develop links between voluntary organizations and museums, nearly 30 museums have agreed to support the joint efforts of AASC and Equinox by offering to card-carrying members of AASC a reduction at the gate or in the museum shops. In return, Equinox will recognize the support of these institutions and publish an up to date list of activities underway in the museums.

There are in Canada in excess of fifty Science Centres and Museums with substantial science and technology contents. A partial list of these is shown in Appendix C.

4.3 Governments and the National Leaders

Good example comes from the top. Visible attention of national leaders to the STS issues is crucial to development of new attitudes. Here again there are currently excellent opportunities for action: The Winnipeg Forum will, we are certain, not only develop new policies but will also send loud signals to the nation about the importance of these policies.

At the federal level, public action on the political forum can now be sustained by the House of Commons Standing Committee on Research, Science and Technology. The low degree of coverage given by the media to the work of this long-awaited Committee has been disappointing to say the least. It confirms the need for breaking the vicious circle of media/public inattention. The Cabinet might find it useful to attract public attention to the work of this Committee. The Committee of Parliamentarians, Scientists and Engineers might also consider doing so.

Few things attract public attention as much as the threat of a radioactive fallout or a good controversy. In time, there is bound to be much controversy associated with the STS issues. We trust that our national leaders from outside the government will take public positions on these issues in order to stimulate constructive debate. The Winnipeg Forum should be only a beginning.

5. CONCLUSION

We have a serious problem. Canadians by and large remain insensitive to the importance of science and technology in their lives, not only in their past, but today and in their future, thus making it difficult for government leaders who reflect the attitude of the people to fashion a science and technology policy with meaning. In our brief, we have focussed on some solutions. We have outlined two approaches to reaching the public both of which are designed to bring about a correcting trend.

The sole objective of the Association for the Advancement of Science in Canada / l'Association pour l'avancement des sciences au Canada and the National Museum of Science and Technology which strongly supports its efforts is to bring about this attitudinal change which can act as a base upon which our political leaders can function.

Consequently, we are calling upon the leaders participating in this Forum to do whatever they can to help in influencing public attitudes, especially by attracting the attention of other leaders and the media.

Sporadic bursts of information will not bring the need for excellence in applications of S & T into the subconsciousness of Canadian psyche. A steady influence is necessary. When we reach our short-term goal of over 100,000 members supported by a magazine, Canada will, for the first time, have a continuing influence of major group focussing at all times on the role of science and technology in our society. This offers a good prospect for also attracting continuing attention of the national leaders and the media, as is indispensable to the colossal task of affecting the national perception.

APPENDIX A

SOME MECHANISMS FOR REACHING THE PUBLIC

Let us consider some of the mechanisms for reaching the public available within Canada and discuss how effective each has been.

Television

There is a wealth of material available to the Canadian public through T.V. programs produced abroad and shown largely through the educational channels in the U.S. and in the various provinces. But none of the programming has Canadian content. The exception in Canada has been the support by the CBC of the provocative programs hosted by Dr.David Suzuki. These have been of international calibre. The number of people viewing each program is large and no doubt reflects the numbers viewing the series.

Too few, excellent programs on science related topics and on the impact of technology have been produced by the National Film Board and by local and provincial T.V. outlets. Unfortunately, there is limited continuing effort to use T.V., the most effective of media, to help Canadians become aware of science and technology in their lives and feel at ease with it. Virtually no one is attempting to help Canadians recognize the significant Canadian achievements that have been made, the contributions that are being made today and potential opportunities for Canadians in the future, even though there are few countries in the world which depend on science and technology more than our own.

Too often the major programs produced in Canada miss opportunities to use Canadian examples of accomplishment or to use Canadian interviewees thus strenghtening the perception by Canadians that they have not made significant contributions to scientific and technological developments in the past, are not contributing today and, by extrapolation, will not contribute tomorrow. Canada has had a rich past which has been largely ignored.

Radio

Limited use is made of radio as a forum to discuss the history and impact of science and technology on Canadians even though it is generally recognized that the quality of Canadian national radio is excellent and that Canadians are good listeners. Because of distance between places, the car radio has become a major tool for communications.

But for "Quirks and Quarks" and "The Medicine Show" both hosted by Jay Ingram, and occasional presentations through the "Ideas" series, only spotty national programming has been developed. Several excellent regional programs have recently been aired but there are too few of them.

There is excellent opportunity to more effectively use this medium as an adjunct to programs prepared by voluntary organizations like ACFAS, the Association for Advancement of Science in Canada, the Youth Science Foundation, or professional groups like the Canadian Association of Physicists and the Historians of Science and Technology in Canada.

Newspapers

Few newspapers have maintained on a continuing basis an editor who has as his or her principal responsibility the science and technology beat. Furthermore, senior editorial staff and news editors seldom give priority to topics related to technology and science, arguing that these things, unlike sports and the funnies, are of little interest to Canadians and consequently "do not sell newspapers".

At best, Canadians can count on little regular objective reporting of scientific and technological matters or interviews with people who are active in this area. It is not a surprise that what appears in our papers is primarily related to either health care or problems in space, microelectronics or biotechnology. Often short notes on these subjects are found buried on the business page.

It is quite significant that the Quebec papers do a better job of covering science related topics than do others across Canada. This perhaps follows from the tremendous success Quebec has had in using research to support its very successful energy programs.

Considerable effort in the future must be given to convincing editors of the popularity and importance of the impact of science and technology in the lives of all Canadians.

Magazines

It is an appalling situation that virtually no space is given to technological topics in our leading magazines like MacLeans and Saturday Night, though the situation appears to be better in the French language MacLean-Hunter publication Actualite. This, of course, reflects the fact that science and technology have not yet become significant patches in the quilt of Canadian culture. It is discouraging that those magazines which we protect from cultural takeover by the U.S., cannot be counted upon to discuss the place of science and technology in developing our future, so critical to their nation's healthy growth.

Canadian publishers argue that anglophone Canadians are satisfied by the discussion on scientific and technological topics which appear in a variety of U.S. journals like OMNI, Discover, and Science '86 and the British Journals like the New Scientist, backed up by more technical U.S. journals like Scientific American and Science. On this ground, they have shied away from publishing a quality S & T journal which would have a wee Canadian bias for Canadian inventions and discoveries and the impact of technology on our citizens. However, in Quebec, the situation appears to be different. There, Quebec Science and Science et Technologie have been successful even though the French magazine Sciences, one of the world's best, is popular in Quebec.

In English-speaking Canada, there is one magazine, Equinox which like the National Geographic, addresses many S & T topics as a major part of its rich venue. To everyone's surprise, it has been a great success with many prize winning authors writing significant articles for it. This magazine, along with the soon to be privatized bilingual NRC journal Science Dimension (distributed free at the present time) have done an effective job of reaching the general public.

Museums and Science Centres

It is one thing to see some things on T.V. or hear about them on the radio or read about them in magazines or newspapers, but it is yet another to see them and touch them in a science museum, science centre or at an exhibition. Already through provincial agencies, like the Ontario Science Centre (OSC), the B.C. Provincial Museum or the Saskatchewan Development Museum, and federally, the National Museum of Science and Technology along with rapidly growing numbers of private hands-on science centres modelled after the OSC, Canada is becoming recognized as a leader in museological areas related to science and technology. The very large attendances at these centres, over 4 million people each year, attest to this. This leadership role has been identified despite the limited funds invested in these laboratories for the people by federal, provincial and municipal governments and by the private sector.

Museums with their extensive collections and curatorial staffs, and science centres with their exhibit development teams, can bring together groups of professionals who can develop and present high quality, hands-on exhibits which effectively serve the needs of the general public and which can be used by the school systems as an important adjunct to their regular curricula. Since Canada, is a world leader in this area, it should build on this leadership position. A newly-formed Canadian Council of Science Centres will serve to catalyse joint efforts between institutions. Furthermore, these institutions already have proven their worth as centres where special traveling exhibitry, radio and T.V. programs, books, reseach publications have been developed. Unfortunately, up until now little focus has been given to the social impact of science and technology on our lives. This is rapidly changing.

International Expositions

In this year of Expo 86, with its TRANSPORTATION and COMMUNICATIONS theme it is important to question expositions' efficiency in reaching the Canadian general public and the world on matters related to science and technology. There is no question but that Expo 67 Man and His World marked an awakening of the world to the potential for investment in Canada and served to help Canadians "feel good about themselves" and about their potential as technological leaders. However, before this could bear fruit, the recession and the governments' indifference led to a quick dissipation of that newly acquired confidence.

Again last year, at Expo 85 in Tsukuba, Japan's Science City, the world focussed upon High Technology while Canada, a leader in many areas of high technology, portrayed itself as a vast land mass with beautiful people, lovely mountains, rivers and sea shores and limitless resources. By contrast, Japan demonstrated itself as a leader in developing friendly technologies which focussed upon the needs of its people. This year in Vancouver, Canada is successfully entertaining people who are visiting Expo but unfortunately, it is again failing to demonstrate its prowess as a leader in the development of the technologies needed to link its people across its great land mass. Somehow, Canada has again allowed its insecurity as a scientific and technological nation to show through even to its own people.

Voluntary Organizations

There are a great many professional organizations that participate in debates on science policy. However, they are not oriented towards dialoguing with the public. The notable exception is the multidisciplinary group ACFAS, l'Association canadienne-francaise pour l'avancement des sciences which has had a tradition of working with the media in French Canada. It now has developed its own journal.

No equivalent association exists in English Canada. Instead, a rapidly growing Association for the Advancement of Science/l'Association pour l'avancement des sciences (AASC) has been formed as a broadly-based popular group including professional scientists and engineers as ordinary members. AASC is planned to reach a membership of near 170,000 early next year as a result of a link with Equinox. Also, extensive linkage with nearly 30 museums and science centres has been developed as part of the combined program.

APPENDIX B

INSTITUTIONAL MEMBERS OF AASC

Sustaining members

Alberta Heritage Foundation for Medical Research
Association canadienne-francaise pour l'avancement des sciences
Association des Medecins de langue francaise du Canada
Biological Council of Canada
Canadian Institute for Scientific and Technical Information
Canadian Aeronautics and Space Institute
Canadian Association for Information Science
Canadian Association of Physicists
Canadian Association of University Teachers
Canadian Astronomical Society
Canadian Council of University Biology Chairmen
Canadian Geoscience Council
Canadian Home Economics Association
Canadian Institute of Forestry
Canadian Meteorological & Oceanographic Society
Canadian Nuclear Association
Canadian Operational Research Society
Canadian Physiological Society
Canadian Psychological Association
Canadian Society of Microbiologists
Chemical Institute of Canada
Dalhousie University
Entomological Society of Canada
Environmental Protection Services
Geological Association of Canada
Industrial Materials Research Institute-National Research Council
Library of Parliament
McGill University
Memorial University of Newfoundland
Royal Canadian Geographic Society
Science Council of British Columbia
Science Council of Canada
Social Science Federation of Canada
Spar Aerospace Limited
Spectroscopy Society of Canada
Sudbury Science Centre
Technical University of Nova Scotia
The Canadian Society for Clinical Investigation
The Genetics Society of Canada
Universite Laval
University of Victoria
Youth Science Foundation

Sustaining Members

Canadian Society of Microbiologists
National Museum of Science and Technology
University of Alberta
University of Manitoba
Universite de Montreal

APPENDIX C

Science Centres and Museums will offer special discounts and premiums to the expanded AASC membership. The following, thus far contacted, have already expressed active support of the idea and of the concept and are considering playing an active role in the project:

Arts, Sciences and Technology Centre, Vancouver
Edmonton Space Science Centre, Edmonton
Calgary Science Centre, Calgary
Saskatchewan Science Centre, Regina
Ontario Science Centre, Toronto
London Regional Children's Museum, London, Ontario
National Museum of Science and Technology, Ottawa
National Museum of Man, Ottawa
National Museum of Natural Sciences, Ottawa
Science North, Sudbury
Manitoba Museum of Man and Nature, Winnipeg
New Brunswick Museum, Saint John, New Brunswick
Societe de la maison des sciences et des techniques,
  Montreal, Quebec
Nova Scotia Museum, Halifax, Nova Scotia
British Columbia Provincial Museum, Victoria
Vancouver Museums and Planetarium Association,
  British Columbia
Provincial Museums of Alberta, Edmonton
Glenbow-Alberta Institute, Calgary
Saskatchewan Western Development Museums, Saskatoon
Royal Ontario Museum, Toronto
Newfoundland Museum, St.John's, Newfoundland

DOCUMENT: 830-220/006

A RESPONSE TO

THE MINISTRY OF STATE FOR SCIENCE & TECHNOLOGY

THROUGH

THE ASSOCIATION OF CANADIAN COMMUNITY COLLEGES

ON

THE DRAFT PAPER "BUILDING OUR STRENGTHS" -- A BACKGROUND PAPER FOR THE NATIONAL FORUM ON THE NATIONAL SCIENCE & TECHNOLOGY POLICY

June 8-10, 1986
Winnipeg, Manitoba

The Association of Canadian Community Colleges
110 Eglinton Avenue West, Second Floor
Toronto, Ontario M4R 1A3 416/489-5925

THE ASSOCIATION OF CANADIAN COMMUNITY COLLEGES

The Association of Canadian Community Colleges (ACCC) was established in 1970 to serve as the national voice of post secondary public educational institutions offering certificate and diploma programs throughout the country. A bilingual organization, the Association currently has 119 member institutions and a number of associate members.

The Association's Board of Directors includes representatives of trustees, students, faculty members, and administrators. The Association serves not only as a policy development and information sharing organization, but has been particularly active in the fields of Canadian Studies, and International Education, and the interface between Industry and the Associations Members.

The Association of Canadian Community Colleges welcomes this opportunity to present its views on the principles underlying a National Science & Technolgoy Policy. In that the Community Colleges have been the largest component of Canadian post secondary education since 1978, they can be a significant factor in both establishing and implementing a National Science & Technology Policy. The colleges educate, retrain, and upgrade the majority of the Canadian qualified work force, and contributes significantly to the transfer of technology to the work place. Additionally, Colleges & Institutes are a major contributor for the reduction of adult illiteracy in Canada. It is also observed that Institutions and Colleges have a solid track record of translating social and economic policy into action at national and provincial levels. In all, then, the Association and its Members have proven to be responsive public institutions applied in nature, resourceful, adaptable, who are having a national reputation for achievement and excellence.

The ACCC responds to government queries regarding matters of national interest through a process which seeks to develop consensus amongst its

membership. The few weeks between the submission of this document and the Conference which follows in June, with this, be given to insure that the comments set out below are broadened include a more national perspective of the Association's Membership. It will also be noted that the comments in the enclosed brief are set out in point form. It is expected that the concomitant narrative will unfold during the group discussions at the Conference itself.

COMMENTS REGARDING "BUILDING ON OUR STRENGTHS"

1. There is today, and there has been every day for the past two decades, a very real need for a National Science & Technology policy. The present Conservative Government is strongly to be commended for giving their attention to this matter. It is hoped that the Government will quickly and insightfully respond to the comments of their Staff, and to those at the Forum in Winnipeg. The work of previous Commissions and Government sponsored symposia have most often failed to produce meaningful long term results.

2. Any policy established by the government must insure that the Investor or Industry is offered relatively long term direction. It is our experience that up to 14 years may be required to take a new product from the idea stage through to large scale plant production and hence to a profitable sales volume sufficient to offset research and pre-production costs. Thus a three or five year Policy will not suffice. A longer term Policy developed in cooperation with Industry and Education should also do much to reduce the risk-adverse attitude of business; an attitude which has become ingrained through decades of short term or non existent government policies and support systems.

3. There is a growing level of evidence that Colleges and Institutes, to a degree perhaps even surpassing that of Universities, have developed an effective and flexible interface with Business and Industry. The current program through the Ministry of Canada Manpower and Immigration documents, that from coast to coast across Canada, Colleges and Institutes are effectively assisting Industry in implementing new technologies and in training their staff to use them appropriately.

4. We would agree that both Universities and Industry are under funded in their desire to provide more basic research. However, any substantial increase in funding must be tied directly to Regional or National Economic objectives.

5. The predicted requirement for 1600 new researchers at the Ph.D. level, to meet R & D levels of 1.5% should be a long term goal for Canada. However, it is unlikely that many of the 1600 will be "in place" and have their first productive idea before 1995. The short term need thus also has to be accounted for in any Science & Technology Policy, and that requires the government's support of Industry obtaining licencing rights in those instances where new Canadian products or technology are being developed; ie. support has to be given to development projects based on the potential basic ideas of others.

6. The faculty required to teach the growing number of students in high technological fields should principally come from a system which enables them to teach in Institutes and Colleges for it is from the latter that National Institutes and Industry will draw most of their employee requirements. For each R & D employee, with University preparation, one usually has associated with them some two to four support staff who have less formal education than that of a four year degree.

7. There is really little evidence to relate the unsatisfactory economic growth of Canada to declining funds available to Universities for capital expenditures. However, it is true that Universities have experienced an erosion their ability to perform, but it is a separate debate as to whether the consequences of that are good or bad.

8. The formula increase over the next five years, by one billion dollars, by the three granting Councils should be altered to enable colleges and institutes--not just universities--to have more alliances with Industry. Similiarly, the recent announcement by the Federal Government to match private sector contributions for University research also should be able to accommodate the applied research and development that is/can be done through Institutions and Colleges. Often colleges have more quickly obtained new high-tech equipment than have universities, and thus are in a better position to undertake applied research.

9. The Background Paper in several instances, cites the need for the Private Sector to respond to new challenges, and offer the CLMPC as one example or model of where this is happening. It is doubtful that this is indeed the case, nor that it will become a good model. Harmonious inter and intra relations be developed amongst the Council Members and this not likely in Canada over the coming decade. Perhaps one requires an educational process, beginning in the public school system, in which develops a significantly heightened concern for the necessary and ongoing positive relationships between community values; power; social values; and economic needs.

10. The three essential components identified by the OECD, for Canda to pursue a course of economic renewal through Science & Technology, are seen as being very relevant and quite necessary for any National Science & Technology Policy.

11. While a minor comment, there would appear to be a contradiction in the last two sentences of the major paragraph on page 23. On one hand it is stated that ".....new jobs in the near future will not require significant changes in educational preparation.....". The following sentence contains "In fact, according to a recent opinion poll of Canadian attitudes to the workplace, the better training of workers was cited as one of the best methods to increase productivity". The thrust of these two sentences should be clarified before they are debated further. However, regardless of this matter, it is clearly important that a higher percentage of Canadians must become scientifically and technologically literate; as well as having first rate skills in learning-how-to-learn.

12. One can most certainly assign/devise roles for Government, Post Secondary Educational Institutions the Private Sector, and Labour, when approaching the development of a National Science Policy. This is probably not a meaningful activity until, through consultation, the Policy first has been established. An iterative consultative process, with increasingly more decisions being taken by government after each

step, should lead to a good working policy. As one approaches the end of this process the appropriate roles for each of the participating parties then can best be ascertained.

13. Finally, one should have concern that a Government's Draft Paper underlying a Canadain National Science & Technology Policy makes no reference at all to the role of Colleges & Institutes—either positively or negatively. Both groups of institutions are richly staffed with people who have been awarded their positions primarily because of their work in the applied areas of Science & Technology. It is the application of new ideas or high technology that will be a benefit to Canada; as will the training of those who will be working directly with the sophisticated equipment and machinery in the laboratories, pilot plants, along the production lines. The ACCC would recommend that, the National Forum take account of the 50% of post secondary staff and students who have chosen not to attend University, or who have come from Universities to obtain practical skills.

Document: 830-220/006

RÉPONSE

PRÉSENTÉE AU MINISTÈRE D'ÉTAT CHARGÉ DES SCIENCES
ET DE LA TECHNOLOGIE

PAR L'ENTREMISE DE

L'ASSOCIATION DES COLLÈGES COMMUNAUTAIRES DU CANADA

À

L'ÉBAUCHE DU DOCUMENT INTITULÉ "LES MOYENS DE NOTRE AVENIR" - DOCUMENT DE TRAVAIL ÉTABLI EN VUE DE LA CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

du 8 au 10 juin 1986
Winnipeg (Manitoba)

L'Association des collèges communautaires du Canada
110 ouest, avenue Eglinton, deuxième étage
Toronto (Ontario) M4R 1A3 (416)489-5925

VEUILLEZ NOTER

L'ASSOCIATION DES COLLÈGES COMMUNAUTAIRES DU CANADA

L'Association des collèges communautaires du Canada (ACCC) a été créée en 1970 pour agir comme porte-parole national des établissements publics d'enseignement postsecondaire qui offrent des programmes menant à des certificats ou à des diplômes. L'Association, qui est bilingue, compte actuellement 119 établissements membres et un certain nombre de membres associés.

Le conseil d'administration de l'Association est formé de représentants des commissaires, étudiants, professeurs et administrateurs. Tout en ayant pour mission d'élaborer des politiques et d'échanger des renseignements, l'Association a été particulièrement active dans les domaines des études canadiennes et de l'éducation internationale ainsi que sur le plan des relations entre l'industrie et les membres de l'ACCC.

L'Association des collèges communautaires du Canada se réjouit de cette occasion qui lui est offerte d'exposer ses vues sur les principes sous-jacents de la politique scientifique et technologique nationale. Les collèges communautaires constituent depuis 1978 le plus important élément de l'enseignement postsecondaire au Canada et, de ce fait, peuvent contribuer de façon considérable à l'établissement et à la mise en oeuvre de la politique nationale en matière de sciences et de technologie. Les collèges forment, recyclent et perfectionnent la majeure partie de la main-d'oeuvre spécialisée canadienne et contribuent grandement au transfert de la technologie au milieu de travail. En outre, les collèges et instituts jouent un rôle de premier plan dans la réduction de l'analphabétisme chez les adultes au Canada. On constate en outre que les institutions et collèges ont fort bien réussi à concrétiser par des actes la politique socio-économique aux échelons national et provincial. En somme, l'Association et ses membres ont prouvé qu'ils étaient des institutions publiques sérieuses, pratiques, ingénieuses, capables de s'adapter, qui jouissent d'une réputation nationale de réussite et d'excellence.

Lorsqu'elle doit répondre aux demandes du gouvernement concernant des questions d'intérêt national, l'ACCC cherche à dégager des consensus parmi ses membres. Au cours des quelques semaines qui s'écouleront entre la présentation du présent document et la conférence de juin, l'ACC s'emploiera à étoffer les observations ci-dessous de ses membres de façon à leur donner une

portée nationale accrue. Il convient également de signaler que les observations formulées dans ce mémoire sont présentées en style télégraphique. Les détails concernant chaque point seront probablement exposés au cours des ateliers à la conférence même.

OBSERVATIONS INSPIRÉES PAR "LES MOYENS DE NOTRE AVENIR"

1. Le besoin d'une politique scientifique et technologique nationale est très réel aujourd'hui et a d'ailleurs été ressenti chaque jour au cours des deux dernières décennies. Il convient de féliciter vivement l'actuel gouvernement conservateur pour s'être intéressé à cette question. On espère qu'il réagira rapidement et de façon perspicace aux observations de ses employés et à celles qui seront formulées à la confédrence de Winnipeg. Dans la plupart des cas, les travaux des commissions et les délibérations des colloques organisés par le gouvernement n'ont pas produit de résultats tangibles à long terme.

2. Il faut que toute politique établie par le gouvernement trace pour les investisseurs ou l'industrie des orientations plus ou moins à long terme. D'après notre expérience, il faut dans certains cas jusqu'à quatorze ans pour concrétiser une idée jusqu'au stade de la production en usine sur une grande échelle et, par conséquent, pour atteindre un volume de ventes suffisant pour compenser le coût de la recherche et des étapes préparatoires à la production. Par conséquent, une politique triennale ou quinquennale ne suffit pas. Une politique à plus long terme élaborée de concert avec l'industrie et le secteur de l'enseignement devrait contribuer beaucoup, par ailleurs, à atténuer la méfiance à l'égard du risque, attitude qui s'est enracinée au fil des décennies de politiques gouvernementales et de systèmes de soutien à court terme, voire inexistants.

3. Il est de plus en plus évident que les collèges et instituts ont réussi - peut-être même mieux que les universités - à établir des relations fructueuses et souples avec les milieux d'affaires et l'industrie. Le programme actuellement mis en oeuvre par le ministère de l'Emploi et de l'Immigration du Canada démontre que, d'un bout à l'autre du pays, les collèges et instituts aident vraiment l'industrie à adopter de nouvelles technologiques et à montrer à leur personnel à s'en servir.

4. Nous admettons que les universités aussi bien que l'industrie reçoivent des subventions insuffisantes pour leur permettre d'accroître la recherche fondamentale comme elles le souhaiteraient. Toutefois, toute augmentation appréciable des crédits doit être directement liée aux objectifs économiques régionaux ou nationaux.

5. Le besoin prévu de 1 600 nouveaux chercheurs nouvellement diplômés du 3e cycle pour mener à des programmes de R-D devant absorber 1,5 pour cent du PNB devrait être un objectif à long terme pour le Canada. Toutefois, il est peu probable qu'un grand nombre de ces 1 600 chercheurs soient "en place" et aient leur première idée productive avant 1995. Toute politique en matière de sciences et de technologie doit donc tenir compte des besoins à court terme, d'où la nécessité pour le gouvernement de favoriser l'obtention par l'industrie des droits de licence dans les cas où de nouveaux produits ou techniques canadiens sont mis au point; en d'autres termes, il faut qu'il appuie les projets de développement fondés sur des idées originales que d'autres peuvent avoir.

6. Les enseignants dont on a besoin pour enseigner aux étudiants de plus en plus nombreux dans les domaines de haute technologie devraient provenir principalement d'un système leur permettant d'exercer leur profession dans des instituts et collèges car c'est là que les instituts nationaux et l'industrie recruteront la plupart de leurs employés. Pour chaque diplômé universitaire qui oeuvre dans le secteur de la R-D, on dénombre habituellement deux à quatre employés de soutien ayant reçu une formation moins formelle que celle qu'on obtient en suivant un cours de quatre ans à l'université.

7. On ne dispose guère de données qui permettraient d'établir un lien entre la croissance économique insatisfaisante du Canada et la réduction des budgets d'immobilisations des universités. Toutefois, il est vrai que les universités ont vu leurs moyens d'exécution s'amenuiser, mais c'est une autre affaire que de se demander si cela est sain.

8. La formule en vertu de laquelle les crédits des trois conseils subventionnaires seront augmentés d'un milliard de dollars au cours des cinq prochaines années devrait être modifiée de façon à permettre aux collèges et instituts - et non pas seulement aux universités - d'accroître les couplages avec l'industrie. De même, l'annonce récente selon laquelle le gouvernement fédéral financera la recherche universitaire à parts égales avec le secteur privé devrait permettre de pourvoir aux besoins en ce qui touche la recherche appliquée et le développement que peuvent faire les institutions et collèges. Souvent, les collèges se sont procuré plus rapidement que les universités le nouveau matériel de haute technologie et sont donc plus en mesure d'effectuer la recherche appliquée.

9. Dans le document de travail, on mentionne plusieurs fois la nécessité pour le secteur privé de s'adapter aux nouveaux défis et on cite le Centre canadien du marché du travail et de la productivité comme modèle ou exemple à suivre. Il est douteux que cela soit vraiment le cas et que l'organisme en question deviendra un bon modèle. Il faut que des relations harmonieuses s'établissent entre les membres du conseil et au sein de celui-ci, scénario qui ne se concrétisera sans doute pas au Canada au cours de la prochaine décennie. On a peut-être besoin d'un processus d'éducation qui débuterait au sein du système d'écoles publiques et qui permettrait une bien meilleure sensibilisation aux rapports nécessaires et concrets entre les valeurs communautaires, la puissance, les valeurs sociales et les besoins économiques.

10. Les trois éléments mentionnés par l'OCDE comme étant essentiels pour que le Canada s'engage dans la voie d'un renouveau économique grâce aux sciences et à la technologie sont perçus comme étant très pertinents et tout à fait nécessaires à toute politique scientifique et technologique nationale.

11. Bien qu'il s'agisse d'une observation secondaire, il semble exister une contradiction entre les deux dernières phrases du principal paragraphe de la page 23. D'une part, on dit : "... les emplois du proche avenir ne nécessiteront pas de changement notable de la formation scolaire ...". Dans la phrase qui suit, ont lit : "Un récent sondage d'opinion au sujet des attidues des travailleurs à

l'égard de la nature de leur travail a indiqué qu'une meilleure formation leur paraît être la façon la plus judicieuse d'accroître la productivité." Ces deux phrases devraient être clarifiées avant de faire l'objet de plus amples discussions. Quoi qu'il en soit, il est certes important qu'un plus grand pourcentage de Canadiens s'initient aux sciences et aux techniques tout en démontrant d'excellentes aptitudes sur le plan des techniques d'apprentissage.

12. Dans l'optique de l'élaboration d'une politique scientifique nationale, on peut très certainement attribuer ou définir des rôles au gouvernement, aux établissements d'enseignement postsecondaire, au secteur privé et aux syndicats. Il est probable toutefois que cette activité deviendra vraiment significative uniquement lorsqu'on sera parvenu, par la consultation, à établir la politique. Un processus de consultation en plusieurs étapes ponctué de décisions de plus en plus nombreuses du gouvernement après chacune d'elles, devrait mener à une bonne politique. Plus le processus progres-serait, plus on serait à même de délimiter les rôles qui conviendraient à chacune des parties.

13. Enfin, il y a lieu de s'inquiéter de ce que l'exposé préliminaire du gouvernement qui sous-tend la politique nationale en matière de sciences et de technologie ne fait aucunement état, de façon positive ou négative, du rôle des collèges et instituts. Ces établissements fourmillent de gens qui doivent leur poste principalement à leurs travaux en sciences et en technologie appliquées. C'est l'application de nouvelles idées ou de la haute technologie, de même que la formation reçue par ceux-là mêmes qui utiliseront l'équipement et la machinerie complexes des laboratoires, des usines pilotes et des chaînes de production, qui profitera au Canada. L'ACCC recommande qu'on tienne compte à la conférence des employés et étudiants de niveau postsecondaire (50 %) qui ont choisi de ne pas fréquenter l'université ou qui y sont allés pour acquérir des connaissances pratiques.

DOCUMENT: 830-220/007

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

The North in a National Science and Technology Policy

Association of Canadian Universities for Northern Studies

June 8-10, 1986
Winnipeg, Manitoba

PLEASE NOTE

Submission to the Hon. Frank Oberle,

Minister of State for Science and Technology

THE NORTH IN A NATIONAL SCIENCE AND TECHNOLOGY POLICY

Minister:

The Association of Canadian Universities for Northern Studies (ACUNS) is an organization of thirty-five Canadian universities (Appendix A) devoted to "the advancement of northern scholarship through education, professional and scientific training, and research". More specifically, the mission of ACUNS is:

> To represent the interests of member universities by influencing government and private sector policies and practices related to the support of northern scholarship.
>
> To establish mechanisms through which resources can be allocated to member universities and northern scholars for the purpose of increasing knowledge of the north and ensuring an appropriate number of trained and skilled northern scientists, managers, and educators.
>
> To enhance opportunities for northern people to become leaders and promoters of excellence in education and research matters important to northern society.
>
> To facilitate through conferences, seminars, research and other methods, the understanding and resolution of northern issues.
>
> To co-operate with other public, private and international agencies and organizations concerned with the advancement, application and impact of northern scholarship.

Clearly, "Science and Technology", however defined, are important parts of this mandate.

In many ways, the Association is typical of Canadian attempts at capitalizing on strengths and minimizing weaknesses of the organization of universities in Confederation. It is remarkable that today thirty-five of Canada's universities have more or less formal structures for dealing with northern (or better, polar) education and research. These structures include institutes such as the Arctic Institute of North America (Calgary), the Boreal Institute for Northern Studies (Alberta), and the Labrador Institute of Northern Studies (Memorial), and Centres such as le Centre d'études nordiques (Laval), and the Centre for Northern Studies and Research (McGill) as well as a variety of less formal (but not necessarily less effective for that), organizations such as those at Queen's, Toronto, Université du Québec à Chicoutimi, Saskatchewan, U.B.C., etc. In addition to the multi-disciplinary focus of "northern studies", which includes a substantial representation of science and technology, our universities are associated in various ways with a number of more specialized science and technology organizations which deal with the polar regions. These include C-CORE (Centre for Cold Ocean Resources Engineering), C-FER (Centre for Frontier Engineering Research), NHRI (National

Hydrology Research Institute), at Memorial, Alberta and Saskatchewan respectively, and specialized groups such as the Northern Medical Unit, Manitoba, the Eastern Arctic Teacher Education Program, etc. Our universities have northern field stations, laboratories and archival and library resources. We also have member universities which operate in relatively isolated northern areas and many more which conduct distance education and other teaching programs in northern areas. Although ACUNS does not claim to represent all of these organizations here, it does consider its mandate as involving the areas of academic activity which they represent and those of thousands of faculty and students directly and indirectly involved with northern education and research. It also, as its terms of reference indicate, considers that part of its mandate is to carry Northern Studies to those yet untouched by them.

Canada's strength in academic northern work lies in the extraordinary diversity of activity at our thirty-five member universities. The national weaknesses in this field of endeavour include the "balkanization" of effort (your background paper and Symons 1984) which is apparent from my last paragraph. The universities set up ACUNS almost ten years ago to cope with this matter. It is still necessary to write a long paragraph in order to convey any impression of Canada's strength in this area of teaching and research, but at least today, someone can write it. And, of course, the knowledge necessary to provide an overview of strengths also allows the identification of weaknesses.

There must, surely, be scores if not hundreds of organizations like ACUNS designed to cope with the advantages and disadvantages of Confederation in education and research. But ACUNS is very different from most of these in that it directs its attention not only towards some sort of a subset of knowledge but also towards a distinctive and very large proportion of the country and of the globe. We do not argue that, say Science and Technology in the North are unique but rather that conditions in the North, human and physical, are sufficiently different to merit special attention and organization. We believe for example, the practice of science in the North will often require a multi-disciplinary perspective and a particular awareness of the human sciences and special ethical principles.

While taking the "universal" view of science, we have little difficulty in accepting the idea of focussing national energies for the furtherance of that science. Our general concern for the North also helps us to easily grasp the idea of Technology which has a characteristically "Canadian" dimension.

More pragmatically, we see ourselves as contributing to the proper management of Canada's North, that is most of the national territory including the north of the provinces and the Territories, which at this point in time have a very limited science base. Neither of the Territories has a university of its own although both are developing science institutes. Because of its involvement with the Territories, ACUNS is a truly "national" body in the sense envisaged by your background paper with its desire for a national Science and Technology policy.

We see Canada as a nation which, after more than a century of Confederation, has at least come to terms with the practicalities of life in the south (which many non-Canadians, of course, think of as the north) but

which has yet to come to terms with its national and global responsibility in the North. Each Canadian is responsible for more real estate than almost any other nation on earth but most of that real estate is "northern" by most measures. We would be shirking our responsibility as a rich developed nation if we did not deliberately focus a good measure of our science and technology energies with this in mind. Also, we submit, like T.H.B. Symons (1973), that such a focussing will result in a more worthwhile Canadian contribution to universal science as in general it is healthy to address problems on one's own doorstep. Canadians are more likely to contribute to mainstream science through the study of polar bears that the study of camels. This is even more self-evident in Technology than in science. The nature of Canada presents both opportunities (e.g. the polar bears) and responsibilities (e.g., again, the polar bears).

The North is a national responsibility. We owe it to the people of the North and to the global community to develop a competence in aspects of Science and Technology which relate to that North. Inasmuch as "northern" science and technology is simply cold weather science and technology, developing that competence is also enlightened self-interest for a country like Canada.

We also argue that the Canadian North represents a special trust which Canada has to the global community. As a relatively small nation managing a large proportion of the globe's land and sea, it behooves us to make the maximum possible use of polar science and technology developed abroad. Not only must Canadian work be effectively passed into the mainstream, we must also make maximum possible use of the huge amount of information available from south polar and north polar work undertaken by other countries. At the present time we have no systematic means of tapping this as a nation. We lack both a focus and network for our own northern information and a national centre which is capable of funnelling in the results of polar work from other countries.

ACUNS is a national university organization and, although we work closely with native groups, the private sector, the provincial governments, the federal government and the Territories, we cannot pretend to represent all "national" science and technology with respect to the North. In our brief on the National Polar Institute (submitted to Hon. David Crombie, 1986), we have, for example, expressed concern with the flow of information in the North between these various areas of national life. Similarly, although we are paying increasing attention to international polar affairs, we do not have the resources to be the national focus for this.

The Arctic Science Act passed by the U.S. Congress in 1984 (Appendix B) is an interesting example of a pragmatic approach to northern science and technology.

The Act mandates an Arctic Research Plan which all U.S. federal agencies must be in compliance with. The National Science Foundation is the lead agency for developing a plan by June 1987.

Background documentation (see Polar Research Board, 1985) identifies the following fields for particular attention: Upper atmosphere and near-earth space physics, Atmosphere sciences, Physical and chemical oceanography, Marine

life sciences, Glaciology and hydrology, Geology and geophysics, Permafrost research, Arctic engineering, Terrestrial and freshwater biology, Medicine and human biology, Social and cultural research, and Economics.

An extremely important part of the plan is the design of a national arctic information network for the U.S.A. (see Sokolov, 1985). The network's purpose is to increase research efficiency and assist decision making by allowing a user, anywhere in the U.S., to ascertain whether information on a particular arctic topic exists and if so, how and where to obtain it. The network is to be designed for a variety of users, not only researchers. It will include "library" and non-library (e.g. digital) information.

The aim is to link existing information systems into a whole, strengthening and filling gaps where necessary. These last indicate the strategic benefits (to, for example, Science and Technology) of an exercise such as this.

Canada has a remarkably large number of very effective polar information systems which are loosely represented by the Northern and Offshore Information Resources group (see ACUNS, 1986 (in prep.)). But we are again faced with thestrengths and weaknesses of "balkanization". None of the systems can claim to be comprehensive and efforts to forge links between them have barely begun. In some ways, of course, the situation in the U.S. is simpler in that the Americans have only one major jurisdiction for their own Arctic work, Alaska, while all of their other polar work, including the huge effort in the Antarctic, is essentially 'national' in character. Also the Library of Congress has an entirely global mandate, so that, for example, it collects and disseminates Soviet Arctic and Antarctic material as a matter of course. By contrast, our 'North' directly involves the Territories, all but three provinces and all major federal ministries. Our national libraries have a very limited mandate in terms of international polar work.

The U.S. Arctic Science Act can be interpreted as an effort to counter-balance the huge Antarctic effort of the United States in recent decades. It is a deliberate attempt to move cold region science back into the northern hemisphere. Both the United States and the U.S.S.R., the main players in cold region science, have focussed great energies in the Antarctic in recent decades. Indeed, the Antarctic is, in many ways, the major source of cold weather science and technology today. Canada is the only developed nation which has yet to sign the Antarctic Treaty.

Canada, with its extremely diverse northern jurisdictions and interests, badly needs a truly national northern information system. We would also benefit more than most from a linked international system. It is not beyond the bounds of possibility, if we could solve the internal problems of 'balkanization', that we could become the linchpin of such a system. Perhaps here, as in other ways, the existence of and responsibility for the North could stimulate us to undertake an exercise which would benefit the whole nation? Perhaps this exercise could begin with Science and Technology?

Your background paper raises the matter of science education. ACUNS, like other university organizations, is deeply concerned with both education and research insofar as they can be separated. While in the early years of our existence we were perhaps more concerned with quantity in northern

studies, today we are greatly concerned with quality. Without overstating the scale of effort possible by a small association, we have tried to stimulate interest in northern topics in schools, colleges as well as the universities. Tens of thousands of university students are today exposed to "northern studies" somewhere in their courses. We see it as important that science and technology students are not only exposed to northern content in their disciplines but also to northern work from other disciplines, within and outside science. It is simply not possible today to undertake good science research or to properly apply science in the North without great awareness of and sensitivity for the special social, political and environmental features of the polar regions.

An indication of the current level of university activity in the North is that more than three hundred university students undertake more or less independent research in the North each year under a single grants program. This is the Northern Scientific Training Program of Indian and Northern Affairs which is specifically designed to support the training of young scholars (for further details see Northline/Point Nord, Vol. 5, No. 4, October 1985 and reports of the Program). We estimate that the number of students in this program could easily be multiplied by three to represent the total number of Canadian and foreign university students working in one way or another in the Canadian North. As mentioned above, we are now organizing a National Student Conference on Northern Studies to identify the best of these young scholars and to establish personal networks between them.

We would, with deference, like to make some special points with respect to science education or better with respect to science and education in the North. While the north of the provinces is increasingly well served by colleges and universities, the Northwest Territories and the Yukon are at relatively early stages in the development of their educational systems, particularly with respect to science. And yet these Territories are already the focus of a very substantial research effort in both the physical and social sciences. Private sector, government and university research programs there are all very large.

We would be glad to do all that we can to focus the science resources in the North linking, for example, high school, satellite and other courses, visiting scientists and students, federal and territorial science officials, private sector science workers, field stations, etc. in each region. Here, as elsewhere, the science community extends beyond the sphere of professional researchers and science managers. In the thinly populated regions of the North, even less than in Canada as a whole, we simply can't afford to fritter away such resources.

At our recent annual meetings in Yellowknife, it was continually expressed to us that the people of the North want, indeed now insist, on an educational component for all science activities in their territory. They want to be fully informed about projects before they begin, while they are in operation, and on completion they want the results returned to them in published form. They want northerners involved in scientific projects in every possible way. It is interesting to translate this point of view to the national perspective of your background paper. Can we afford to take less than full advantage of work undertaken in Canada by foreign scientists? Are we taking full educational advantage of the work of our own scientists?

The people of the North, being remarkably conscious of the global significance of their concerns (for example migratory mammals, environmental impacts on permafrost and sea ice) want to be tuned in to national and international "knowhow". People in the Mackenzie for example, want to know about caribou work in Quebec and in the U.S.S.R. Again surely there is a message for the nation as a whole.

The people of the North can certainly speak for themselves in these matters. We make these points as an association of universities which has a special debt to northerners and as an association which contains many northern students and faculty.

We also include in our universities many native students and faculty, northerners and non-northerners. The N.W.T., a region of special concern to us, is the last jurisdiction in North America where natives are a clear majority. Again at our meetings in Yellowknife, and elsewhere, special needs of native peoples and their special contributions to knowledge were stressed. In terms of Science and Technology, we would make two broad points. One is that special efforts must continue to be made to improve science education in the native community. Their particular medical and environmental concerns are good illustrations of the real need here. Also, Canada must make a real effort to tap the traditional knowledge (in this case in science and technology) of the various native groups. Some work on ethnobotany and medicine and in environmental research, involving cooperation between hunters and trappers and conventional scientists, has already illustrated the value of this approach. We urge that Canada not ignore this resource, especially for the North.

Thus, Minister, we urge that any articulation of a national policy for Science and Technology implicitly and explicitly recognize that Canada is a polar nation and that her Science and Technology should reflect that fact. This would be a clear recognition of our global responsibility and would be in the best interests of the nation.

The existence of the Canadian North has already had the effect of bringing together, in organizations within individual universities and in ACUNS, scholars from diverse disciplines in thirty-five diverse universities. Perhaps now it can provide one useful, tangible, focus for a national strategy in higher education and research which in the long run is the only firm basis for a national policy on Science and Technology.

We attach summary responses to the questions posed in your background paper.

W. Peter Adams
Executive Director
May 13, 1986

We regret that as your request for this paper came after our annual meetings and at a time when many of our scholars are in the field, it has not been possible to tap the full resources of ACUNS in producing this report. In most cases, it has not been possible even to consult our members. As a result, the above should be regarded as a preliminary statement written largely by the above-signed.

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APPENDIX A

MEMBERS OF THE ASSOCIATION OF CANADIAN UNIVERSITIES FOR NORTHERN STUDIES

University of Alberta
Athabasca University
Brandon University
University of British Columbia
University of Calgary
Carleton University
Concordia University
Dalhousie University
École Polytechnique
University of Guelph
Lakehead University
Laurentian University
Université Laval
University of Manitoba
McGill University
McMaster University
Memorial University
Université de Montréal
University of New Brunswick
University of Ottawa
Université du Québec à Chicoutimi
Université du Québec à Montréal
Université du Québec à Trois-Rivières
Université du Québec en Abitibi-Témiscamingue
Queen's University
University of Regina
Ryerson Polytechnical Institute
University of Saskatchewan
Simon Fraser University
University of Toronto
Trent University
University of Waterloo
University of Western Ontario
University of Windsor
York University

S. 373

Arctic Policy Act only

Ninety-eighth Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the twenty-third day of January, one thousand nine hundred and eighty-four

An Act

To provide for a comprehensive national policy dealing with national research needs and objectives in the Arctic, for a National Critical Materials Council, for development of a continuing and comprehensive national materials policy, for programs necessary to carry out that policy, including Federal programs of advanced materials research and technology, and for innovation in basic materials industries, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—ARCTIC RESEARCH AND POLICY

SHORT TITLE

SEC. 101. This title may be cited as the "Arctic Research and Policy Act of 1984".

FINDINGS AND PURPOSES

SEC. 102. (a) The Congress finds and declares that—

(1) the Arctic, onshore and offshore, contains vital energy resources that can reduce the Nation's dependence on foreign oil and improve the national balance of payments;

(2) as the Nation's only common border with the Soviet Union, the Arctic is critical to national defense;

(3) the renewable resources of the Arctic, specifically fish and other seafood, represent one of the Nation's greatest commercial assets;

(4) Arctic conditions directly affect global weather patterns and must be understood in order to promote better agricultural management throughout the United States;

(5) industrial pollution not originating in the Arctic region collects in the polar air mass, has the potential to disrupt global weather patterns, and must be controlled through international cooperation and consultation;

(6) the Arctic is a natural laboratory for research into human health and adaptation, physical and psychological, to climates of extreme cold and isolation and may provide information crucial for future defense needs;

(7) atmospheric conditions peculiar to the Arctic make the Arctic a unique testing ground for research into high latitude communications, which is likely to be crucial for future defense needs;

(8) Arctic marine technology is critical to cost-effective recovery and transportation of energy resources and to the national defense;

(9) the United States has important security, economic, and environmental interests in developing and maintaining a fleet of icebreaking vessels capable of operating effectively in the heavy ice regions of the Arctic;

(10) most Arctic-rim countries, particularly the Soviet Union, possess Arctic technologies far more advanced than those currently available in the United States;

(11) Federal Arctic research is fragmented and uncoordinated at the present time, leading to the neglect of certain areas of research and to unnecessary duplication of effort in other areas of research;

(12) improved logistical coordination and support for Arctic research and better dissemination of research data and information is necessary to increase the efficiency and utility of national Arctic research efforts;

(13) a comprehensive national policy and program plan to organize and fund currently neglected scientific research with respect to the Arctic is necessary to fulfill national objectives in Arctic research;

(14) the Federal Government, in cooperation with State and local governments, should focus its efforts on the collection and characterization of basic data related to biological, materials, geophysical, social, and behavioral phenomena in the Arctic;

(15) research into the long-range health, environmental, and social effects of development in the Arctic is necessary to mitigate the adverse consequences of that development to the land and its residents;

(16) Arctic research expands knowledge of the Arctic, which can enhance the lives of Arctic residents, increase opportunities for international cooperation among Arctic-rim countries, and facilitate the formulation of national policy for the Arctic; and

(17) the Alaskan Arctic provides an essential habitat for marine mammals, migratory waterfowl, and other forms of wildlife which are important to the Nation and which are essential to Arctic residents.

(b) The purposes of this title are—

(1) to establish national policy, priorities, and goals and to provide a Federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences;

(2) to establish an Arctic Research Commission to promote Arctic research and to recommend Arctic research policy;

(3) to designate the National Science Foundation as the lead agency responsible for implementing Arctic research policy; and

(4) to establish an Interagency Arctic Research Policy Committee to develop a national Arctic research policy and a five year plan to implement that policy.

ARCTIC RESEARCH COMMISSION

SEC. 103. (a) The President shall establish an Arctic Research Commission (hereafter referred to as the "Commission").

(b)(1) The Commission shall be composed of five members appointed by the President, with the Director of the National Science Foundation serving as a nonvoting, ex officio member. The members appointed by the President shall include—

(A) three members appointed from among individuals from academic or other research institutions with expertise in areas of research relating to the Arctic, including the physical, biological, health, environmental, social, and behavioral sciences;

(B) one member appointed from among indigenous residents of the Arctic who are representative of the needs and interests of Arctic residents and who live in areas directly affected by Arctic resource development; and

(C) one member appointed from among individuals familiar with the Arctic and representative of the needs and interests of private industry undertaking resource development in the Arctic.

(2) The President shall designate one of the appointed members of the Commission to be chairperson of the Commission.

(c)(1) Except as provided in paragraph (2) of this subsection, the term of office of each member of the Commission appointed under subsection (b)(1) shall be four years.

(2) Of the members of the Commission originally appointed under subsection (b)(1)—

(A) one shall be appointed for a term of two years;

(B) two shall be appointed for a term of three years; and

(C) two shall be appointed for a term of four years.

(3) Any vacancy occurring in the membership of the Commission shall be filled, after notice of the vacancy is published in the Federal Register, in the manner provided by the preceding provisions of this section, for the remainder of the unexpired term.

(4) A member may serve after the expiration of the member's term of office until the President appoints a successor.

(5) A member may serve consecutive terms beyond the member's original appointment.

(d)(1) Members of the Commission may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. A member of the Commission not presently employed for compensation shall be compensated at a rate equal to the daily equivalent of the rate for GS-16 of the General Schedule under section 5332 of title 5, United States Code, for each day the member is engaged in the actual performance of his duties as a member of the Commission, not to exceed 90 days of service each year. Except for the purposes of chapter 81 of title 5 (relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims), a member of the Commission shall not be considered an employee of the United States for any purpose.

(2) The Commission shall meet at the call of its Chairman or a majority of its members.

(3) Each Federal agency referred to in section 107(b) may designate a representative to participate as an observer with the Commission. These representatives shall report to and advise the Commission on the activities relating to Arctic research of their agencies.

(4) The Commission shall conduct at least one public meeting in the State of Alaska annually.

DUTIES OF COMMISSION

SEC. 104. (a) The Commission shall—

(1) develop and recommend an integrated national Arctic research policy;

(2) in cooperation with the Interagency Arctic Research Policy Committee established under section 107, assist in establishing a national Arctic research program plan to implement the Arctic research policy;

(3) facilitate cooperation between the Federal Government and State and local governments with respect to Arctic research;

(4) review Federal research programs in the Arctic and suggest improvements in coordination among programs;

(5) recommend methods to improve logistical planning and support for Arctic research as may be appropriate and in accordance with the findings and purposes of this title;

(6) suggest methods for improving efficient sharing and dissemination of data and information on the Arctic among interested public and private institutions;

(7) offer other recommendations and advice to the Interagency Committee established under section 107 as it may find appropriate; and

(8) cooperate with the Governor of the State of Alaska and with agencies and organizations of that State which the Governor may designate with respect to the formulation of Arctic research policy.

(b) Not later than January 31 of each year, the Commission shall—

(1) publish a statement of goals and objectives with respect to Arctic research to guide the Interagency Committee established under section 107 in the performance of its duties; and

(2) submit to the President and to the Congress a report describing the activities and accomplishments of the Commission during the immediately preceding fiscal year.

COOPERATION WITH THE COMMISSION

SEC. 105. (a)(1) The Commission may acquire from the head of any Federal agency unclassified data, reports, and other nonproprietary information with respect to Arctic research in the possession of the agency which the Commission considers useful in the discharge of its duties.

(2) Each agency shall cooperate with the Commission and furnish all data, reports, and other information requested by the Commission to the extent permitted by law; except that no agency need furnish any information which it is permitted to withhold under section 552 of title 5, United States Code.

(b) With the consent of the appropriate agency head, the Commission may utilize the facilities and services of any Federal agency to the extent that the facilities and services are needed for the establishment and development of an Arctic research policy, upon reimbursement to be agreed upon by the Commission and the agency head and taking every feasible step to avoid duplication of effort.

(c) All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research.

ADMINISTRATION OF THE COMMISSION

SEC. 106. The Commission may—

(1) in accordance with the civil service laws and subchapter III of chapter 53 of title 5, United States Code, appoint and fix the compensation of an Executive Director and necessary additional staff personnel, but not to exceed a total of seven compensated personnel;

(2) procure temporary and intermittent services as authorized by section 3109 of title 5, United States Code;

(3) enter into contracts and procure supplies, services, and personal property; and

(4) enter into agreements with the General Services Administration for the procurement of necessary financial and administrative services, for which payment shall be made by reimbursement from funds of the Commission in amounts to be agreed upon by the Commission and the Administrator of the General Services Administration.

LEAD AGENCY AND INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

SEC. 107. (a) The National Science Foundation is designated as the lead agency responsible for implementing Arctic research policy, and the Director of the National Science Foundation shall insure that the requirements of section 108 are fulfilled.

(b)(1) The President shall establish an Interagency Arctic Research Policy Committee (hereinafter referred to as the "Interagency Committee").

(2) The Interagency Committee shall be composed of representatives of the following Federal agencies or offices:

(A) the National Science Foundation;
(B) the Department of Commerce;
(C) the Department of Defense;
(D) the Department of Energy;
(E) the Department of the Interior;
(F) the Department of State;
(G) the Department of Transportation;
(H) the Department of Health and Human Services;
(I) the National Aeronautics and Space Administration;
(J) the Environmental Protection Agency; and
(K) any other agency or office deemed appropriate.

(3) The representative of the National Science Foundation shall serve as the Chairperson of the Interagency Committee.

DUTIES OF THE INTERAGENCY COMMITTEE

SEC. 108. (a) The Interagency Committee shall—

(1) survey Arctic research conducted by Federal, State, and local agencies, universities, and other public and private institutions to help determine priorities for future Arctic research, including natural resources and materials, physical and biological sciences, and social and behavioral sciences;

(2) work with the Commission to develop and establish an integrated national Arctic research policy that will guide Federal agencies in developing and implementing their research programs in the Arctic;

(3) consult with the Commission on—

(A) the development of the national Arctic research policy and the 5-year plan implementing the policy;

(B) Arctic research programs of Federal agencies;

(C) recommendations of the Commission on future Arctic research; and

(D) guidelines for Federal agencies for awarding and administering Arctic research grants;

(4) develop a 5-year plan to implement the national policy, as provided for in section 109;

(5) provide the necessary coordination, data, and assistance for the preparation of a single integrated, coherent, and multiagency budget request for Arctic research as provided for in section 110;

(6) facilitate cooperation between the Federal Government and State and local governments in Arctic research, and recommend the undertaking of neglected areas of research in accordance with the findings and purposes of this title;

(7) coordinate and promote cooperative Arctic scientific research programs with other nations, subject to the foreign policy guidance of the Secretary of State;

(8) cooperate with the Governor of the State of Alaska in fulfilling its responsibilities under this title;

(9) promote Federal interagency coordination of all Arctic research activities, including—

(A) logistical planning and coordination; and

(B) the sharing of data and information associated with Arctic research, subject to section 552 of title 5, United States Code; and

(10) provide public notice of its meetings and an opportunity for the public to participate in the development and implementation of national Arctic research policy.

(b) Not later than January 31, 1986, and biennially thereafter, the Interagency Committee shall submit to the Congress through the President, a brief, concise report containing—

(1) a statement of the activities and accomplishments of the Interagency Committee since its last report; and

(2) a description of the activities of the Commission, detailing with particularity the recommendations of the Commission with respect to Federal activities in Arctic research.

5-YEAR ARCTIC RESEARCH PLAN

SEC. 109. (a) The Interagency Committee, in consultation with the Commission, the Governor of the State of Alaska, the residents of the Arctic, the private sector, and public interest groups, shall prepare a comprehensive 5-year program plan (hereinafter referred to as the "Plan") for the overall Federal effort in Arctic research. The Plan shall be prepared and submitted to the President for transmittal to the Congress within one year after the enactment of this Act and shall be revised biennially thereafter.

(b) The Plan shall contain but need not be limited to the following elements:

(1) an assessment of national needs and problems regarding the Arctic and the research necessary to address those needs or problems;

(2) a statement of the goals and objectives of the Interagency Committee for national Arctic research;

(3) a detailed listing of all existing Federal programs relating to Arctic research, including the existing goals, funding levels for each of the 5 following fiscal years, and the funds currently being expended to conduct the programs;

(4) recommendations for necessary program changes and other proposals to meet the requirements of the policy and goals

as set forth by the Commission and in the Plan as currently in effect; and

(5) a description of the actions taken by the Interagency Committee to coordinate the budget review process in order to ensure interagency coordination and cooperation in (A) carrying out Federal Arctic research programs, and (B) eliminating unnecessary duplication of effort among these programs.

COORDINATION AND REVIEW OF BUDGET REQUESTS

SEC. 110. (a) The Office of Science and Technology Policy shall—

(1) review all agency and department budget requests related to the Arctic transmitted pursuant to section 108(a)(5), in accordance with the national Arctic research policy and the 5-year program under section 108(a)(2) and section 109, respectively; and

(2) consult closely with the Interagency Committee and the Commission to guide the Office of Science and Technology Policy's efforts.

(b)(1) The Office of Management and Budget shall consider all Federal agency requests for research related to the Arctic as one integrated, coherent, and multiagency request which shall be reviewed by the Office of Management and Budget prior to submission of the President's annual budget request for its adherence to the Plan. The Commission shall, after submission of the President's annual budget request, review the request and report to Congress on adherence to the Plan.

(2) The Office of Management and Budget shall seek to facilitate planning for the design, procurement, maintenance, deployment, and operations of icebreakers needed to provide a platform for Arctic research by allocating all funds necessary to support icebreaking operations, except for recurring incremental costs associated with specific projects, to the Coast Guard.

AUTHORIZATION OF APPROPRIATIONS; NEW SPENDING AUTHORITY

SEC. 111. (a) There are authorized to be appropriated such sums as may be necessary for carrying out this title.

(b) Any new spending authority (within the meaning of section 401 of the Congressional Budget Act of 1974) which is provided under this title shall be effective for any fiscal year only to such extent or in such amounts as may be provided in appropriation Acts.

DEFINITION

SEC. 112. As used in this title, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.

TITLE II—NATIONAL CRITICAL MATERIALS ACT OF 1984

SHORT TITLE

SEC. 201. This title may be cited as the "National Critical Materials Act of 1984".

Responses to questions posed in the Background Paper

(Building on our Strengths, MOSST, April 22, 1986)

to be read in conjunction with ACUNS' submission

DEVELOPING AND ACQUIRING NEW KNOWLEDGE

1a. Is Canada getting maximum beneits from money spent on university research? If not, what steps should be taken to improve the situation?

The general thrust of our brief is that more cooperation and coordination between all players in Science and Technology in the North is desirable and would lead to more effective use of existing resources. We believe that ACUNS' roles within universities have already resulted in more effective use of resources. Simple examples of this have been our efforts to increase awareness of northern field stations (with a view to reducing living costs of researchers, maximizing the use of aircraft taking groups in and out, etc.) and to improve the evaluation of existing grant programs. At base, we are a 'networking' organization. Effective networking, in the long run, ensures effective use of funds (see #6 below).

ACUNS' efforts become less effective as we reach out from our particular, university, community.

1b. If new money were to become available, should it be used for university research and, if so, how should it be spent to assure maximum benefit to the country?

We do believe that the universities are a particularly useful vehicle for Science and Technology in the North and so should be major recipients of new funds. In many ways, the universities bridge gaps between private sector, governments, and northern peoples.

Nevertheless, we deeply regret that the cold regions research and engineering facility ("NRC West") planned for Edmonton was cut. The national effort in various aspects of cold weather engineering is now very weak and unfocussed and merits new support.

We also believe that marine Science and Technology, in the broader sense, and to a lesser extent its freshwater equivalent, merit special national attention, especially in the North. The demands of the extended economic off-shore zone, of provisions of the Law of the Sea with respect to ice-covered waters, the transportational and environmental implications of arctic sovereignty and the subsistence and other needs of the native peoples, have all created demands which cannot be met at present.

Also, again especially in the North, social and economic implications of Science and Technology merit greatly increased attention. We include here the points made in our submission about aboriginal science. In future, effective and ethical science cannot be practiced without full consideration of these implications.

1c. Are you satisfied with the rate of progress toward university-industry cooperation in science and technology? Should it be further encouraged and, if so, how can we foster better linkage between the private sector and universities?

Most university researchers, engineers and science managers in the North are more conscious of the advantages of cooperation with industry (and governments) than their counterparts in the South. ACUNS has deliberately tried to reach out to industry with some success in terms of productive joint symposia and workshops, scholarship programs, etc. We would again stress that the involvement of the public ("user groups") is an important part of university-industry (-government) relations in Science and Technology.

1d. How can your organization help Canada to develop our intellectual capital so that it can be applied to Canada's needs? so that Canada can acquire new knowledge? in the training of highly-qualified personnel?

We already help, and with additional support could help further, here through our 'networking' functions which increase cooperation, improve flows of knowledge, make dissemination of knowledge more effective, encourage effective training, etc. etc. (see #6 below). Our National Student Conference next November, for example, is a deliberate attempt at honing quality after many years devoted, of necessity, to quantity.

It would be highly desirable to extend these activities even further into the non-university area.

2a. Is Canada getting maximum benefits from money spent on <u>government laboratories</u>? and, if so, how should it be spent to assure maximum benefit to the country?

See the point made above (#1b) about cold weather research and engineering. The NRC has played a critical role in this type of Science and Technology. The scale and expense of some types of science and technology in the North (and nationally) requires direct government involvement. The NRC should continue to receive considerable support for work of this type. It should also be encouraged to increase the flow of scientists between it and the universities. Other federal laboratories, such as the Freshwater Institute in Winnipeg, the National Hydrology Research Institute in Saskatoon and the Institute of Marine Dynamics in St. John's, also play important roles in Science and Technology in the North. We note that each of these is clearly associated with a university - physically and/or organizationally. Training and other benefits of these associations are enormous.

Attempts are being made to make better use of the federal field stations in the Territories. Efforts here should be intensified. Universities, colleges, schools, industry, native groups, and others, in the North and the South, could well be involved.

2b. If new money were to become available, should it be used for <u>government laboratories</u>? and, if so, how should it be spent to assure maximum benefit to the country?

See #1b and 2a above.

2c. Are you satisfied with the rate of progress toward government-industry cooperation in science and technology? Should it be further encouraged and, if so, how can we foster better linkage between the private sector and government laboratories?

See #1c.

In the North, we should perhaps accept the fact that there will, for many years, be a major role for governments. The Environmental Studies Revolving Fund, in which petroleum industry funds are pooled for northern and offshore research, for administration by a federal agency, might be a useful model here. Among other things, it reduces duplication and ensures relatively prompt publication of results.

3. How could Canada realize more benefits from international science and technology developments? Be more involved in the international S&T networks? In contributing Canadian expertise to international development and cooperation? In recruiting scientists of other countries to share their knowledge in Canada? How can my organization or sector play a greater role in this?

We have stressed this in our submission. In the North, we simply cannot afford to try to develop effective Science and Technology without fully tapping the enormous amount of non-Canadian work in polar regions, including Antarctica. We are not yet effectively tapping northern work undertaken in Canada by foreign nationals.

There is a real need for a national point of contact for international polar work, especially that undertaken by the U.S.A. and the U.S.S.R. In our view, the universities should be more directly involved in the Canada-U.S.S.R. exchanges.

ACUNS has had to devote much of its attention to linking and focussing university work in Canada. We have (for example through our circumpolar Arctic Heritage Symposium, through contacts with the Nordic Council, the Northern Libraries Colloquy, the Inuit Circumpolar Conference, and polar institutes in many countries) made some efforts at improving Canada's links with the international science community, especially in the universities. Our present resources limit our scope here.

However, we have barely touched the non-university areas.

A major national forum, followed by a major international forum on Science and Technology in the North would be extremely useful at this time. Such meetings could involve industry, government, native peoples and universities in Canada and abroad.

PUTTING KNOWLEDGE TO WORK AND REALIZING OPPORTUNITIES

4. Should Canada target its science and technology resources in a range of strategic areas so as to maximize return? If so, how?

See #1b, above and various parts of our submission.

Surely the time is near when an evaluation of existing Strategic Grants programs of the Granting Councils would be worthwhile? How are they working? Have the initial concerns been realized? Have the initial hopes been realized?

5. What can government do to make sure that Canada's companies are using the best available technologies? What can your organization or sector do to help?

We repeat that in the North it is likely that governments must continue to play a large role in Science and Technology. This is in the national as

well as the northern interest. We suspect that Canada's companies, even more than Canada's universities, are unevenly plugged into the mainstream of polar Science and Technology. A greater focussing of national effort is required (see, for example, #3 above).

6. What can your organization or sector do to improve methods for diffusing new technologies? Enhancing technology transfer? Making possible development, commercialization, financing, and marketing in all areas of our business sector?

While recognizing that this question refers specifically to diffusing technologies, we would reinforce points that we have made with respect to the importance of 'networking'. This is not a simple matter, it is not just a matter of a new newsletter, a new journal or an advertising campaign.

ACUNS, for example, conducts annual meetings which bring together faculty from different disciplines in thirty-five universities and private and public sector persons involved with the North and living in the North. We conduct symposia and workshops on selected themes (for example, Northern Engineering: Organization and Policy, Social Science in the North, Higher Education, Research and Information Systems in the North). We produce a variety of publications (e.g. the List of Northern Specialists at Canadian Universities, which provides an entrée to the academic and regional specialties of 600 Canadian faculty; Ethical Principles for the Conduct of Research in the North). We conduct scholarship programs which influence the career decisions of students (e.g. the Canadian Northern Studies Trust which provides substantial scholarships for students who are outstanding academically and Special Awards for Northern Residents, and a program for Native students undertaking graduate work in business studies). We stimulate northern studies teaching through visiting lecturer programs and a National Student Conference. We maintain an office which acts as a central point in our network of universities and which links them with government and industry and with polar work abroad. The office publishes a regular newsletter, Northline, which has a readership of 2,000. All of these are examples of activities which are involved in effective 'networking' in an area of scholarship. These activities involve stages in Science and Technology which range from education in the schools to the development and diffusion of new products.

We suspect that in national Science and Technology, there is no quick fix for the current problems. The entire education and research system needs careful attention. An overall strategy is required. We sense that Confederation is working well for education up to some level but that thereafter it works less well, to the detriment of Science and Technology. We have difficulty defining the level concerned!

7. By what mechanisms could governments encourage linkages between advanced technology and machinery companies on the one hand, and the existing resource sectors on the other? Why do these linkages seem insufficient at the moment, and what can be done about strengthening them?

No comment.

8. How could pre-venture capital be fostered and targeted to the high-risk advanced technology industries? What is the provincial role as compared to the federal role?

No comment.

ADAPTING TO CHANGE

9. What can we do to help Canadians deal with the dramatic sweeping changes in all aspects of life which technological change will confront us with in the next two decades? to develop a new spirit of collaboration instead of confrontation and competition? to ensure that technological change is managed in an intelligent and equitable fashion? to promote greater public awareness of, and participation in, the issues of science and technology?

We repeat that a key element here is the involvement, from the very beginning, of those who are not directly involved in Science and Technology, or, better, their involvement on an ongoing basis. We are particularly conscious of this in the North but there should be greater attention paid to it nationally.

In the North also (as is exemplified by the existence of this Association) there are closer links between the physical sciences and engineering and other sciences, including medicine, and between them and the social sciences and humanities. Concern with social and environmental impact of technological activity and the current stage of social and political development in the Territories have been important factors. Again we would suggest that there are lessons in the northern situation for Canada as a whole.

10. Given market forces, the need for "critical mass", and the tendency of advanced technology businesses to locate in clusters -- all of which lead to concentration -- what should be done by government and by other sectors to ensure regional balance?

We have some problems with "regional balance". How does such a concept apply to the North, broadly or narrowly defined? One suspects that a sustained government role is likely the best course in the North - as far as possible involving partnerships with user groups and industry. One purpose of this involvement would be to minimize the problems of a boom or bust economy.

11. What measures need to be taken to enhance the joint collaboration of labour and management in the introduction of new technologies?

Again, the North would appear to be rather special in terms of the roles of both management and unions.

PUTTING A NATIONAL SCIENCE AND TECHNOLOGY STRATEGY TO WORK

12. In the successful development and implementation of a National Science and Technology Policy, what are the respective roles of the federal government? provincial governments? universities? the private sector? labour? non-governmental organizations? your own organization or sector?

We repeat our point that the North is rather special in terms of government-industry relations. We assume that any national strategy will take this into account. The private sector might, for example, play a dominant role in Science and Technology in southern Ontario while the government might

dominate in the North.

The universities, as relatively neutral organizations, which involve all the main players in Science and Technology and which reach down into the schools, have developed a very special place in northern Science and Technology.

13. What can your organization or sector do to ensure continued coordination and collaboration with all other participants in the effort? Is there a particular mechanism that would make this collaboration more effective? What targets can be set that will guide in the implementation of the policy?

See #3 above and our submission.

We sense that a national strategy in education and research would be the best basis for a national policy on Science and Technology. This involves all sectors of national life.

We suggest that Science and Technology of the North might be one useful focus for such a national policy.

14. Do you have any other suggestions regarding a National Science and Technology Policy and the role to be played by sectors such as your own?

The northern parts of the provinces are increasingly well served by local universities and colleges and distance education programs from southern universities. However, despite the huge presence of government, private sector and university research programs (Canadian and foreign), neither Territory has a university nor a well developed research institute (the Science Institute of the N.W.T. has just come into existence). The Arctic College operates in the N.W.T., the Yukon College is developing, but neither has a real Science and Technology capacity as yet. There are various reasons for this state of affairs, some good and some bad. But one important reason for the lack of spinoff from the large research programs in the North has been the lack of continuity which characterizes many of them. Any national policy or strategy should address this.

It should be borne in mind that every other major jurisdiction in the circumpolar region has both universities and institutes in its northern territory.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

La politique nationale des sciences et de la technologie et le nord

Association universitaire canadienne d'études nordiques

du 8 au 10 juin 1986
Winnipeg (Manitoba)

Mémoire présenté à M. Frank Oberle,

Ministre d'État aux Sciences et à la Technologie

LA POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE ET LE NORD

Monsieur le ministre,

L'Association universitaire canadienne d'études nordiques (AUCEN) regroupe trente-cinq universités canadiennes (annexe A), dont le but commun est "de faire progresser les connaissances nordiques grâce à l'éducation et à la formation de scientifiques et d'autres spécialistes, et à la recherche. Plus précisément, l'AUCEN a pour mission :

> De promouvoir les intérêts des universités membres en influençant les politiques et l'action des autorités publiques et du secteur privé en matière de soutien des études nordiques.
>
> De mettre sur pied des mécanismes grâce auxquels les ressources sont attribuées aux universités membres et aux spécialistes du Nord, afin qu'ils accroissent la masse des connaissances sur le Nord et assurent qu'il existe un nombre suffisant de scientifiques, d'administrateurs et d'enseignants formés et qualifiés en matières nordiques.
>
> D'élargir, pour les nord-canadiens, les possibilités de frayer la voie à un enseignement de qualité, et de le promouvoir ainsi que les recherches sur les questions nordiques importantes pour la collectivité nordique.
>
> De faciliter la compréhension et la résolution des problèmes du Nord grâce à la convocation de conférences et de séminaires, à l'accomplissement de recherches et à d'autres méthodes.
>
> De collaborer avec d'autres organismes publics, privés et internationaux s'occupant de développer la masse des connaissances nordiques et leurs applications, et d'évaluer leurs effets."

De toute évidence, les sciences et la technologie sont, peu importe l'acception qui leur est donnée, des éléments importants de ce mandat.

L'Association est, sous plusieurs rapports, l'expression typique des efforts que font les Canadiens pour exploiter les points forts et atténuer les points faibles de l'organisation des universités de la Confédération. Fait remarquable, trente-cinq des universités canadiennes sont aujourd'hui dotées d'un organe plus ou moins structuré d'enseignement et de recherche nordiques (ou mieux, polaires). Ce sont notamment l'Arctic Institute of North America (Calgary), le Boreal Institute for Northern Studies (Alberta) et le Labrador Institute of Northern Studies (Memorial), ainsi que des centres tels le Centre d'études nordiques (Laval) et le Centre for Northern Studies and Research (McGill). Il existe également des organisations moins structurées (mais pas nécessairement moins efficaces), à l'Université Queen's et aux Universités de Toronto, du Québec à Chicoutimi, de Saskatchewan et de Colombie-Britannique, par exemple.

Sans compter que l'approche multidisciplinaire des "études nordiques" met en cause un bon nombre de sciences et de techniques, nos universités sont aussi associées de diverses façons à des organisations scientifiques et technologiques plus spécialisées, qui s'intéressent aux régions polaires. Ainsi, elles collaborent avec le C-CORE (Centre for Cold Ocean Resources Engineering), le C-FER (Centre for Frontier Engineering Research), l'INRH (Institut national de recherche en hydrologie), qui se trouvent respectivement à l'Université Memorial, à l'Université de l'Alberta et à l'Université de Saskatchewan, et avec des groupes spécialisés comme le Northern Medical Unit du Manitoba, le Programme de formation des enseignants de l'Artique est, etc.

Nos universités ont des stations dans le Nord et tiennent des laboratoires, des archives et des bibliothèques spécialisés. Nous avons aussi des membres qui oeuvrent dans des régions assez isolées du Nord et beaucoup d'autres qui participent à des programmes de téléenseignement et à d'autres formes d'enseignement dans les régions du Nord. Bien que l'AUCEN ne prétend pas représenter toutes ces organisations, elle estime que son mandat englobe les domaines d'activité scolaire auxquels ces organisations s'intéressent, ainsi que ceux de milliers d'enseignants et d'étudiants qui participent directement ou indirectement à l'enseignement et à la recherche dans le Nord. Comme son mandat l'indique, l'Association estime de plus avoir la responsabilité de faire connaître les études nordiques à ceux qui n'en sont pas informés.

La vigueur du Canada dans le domaine des études et des recherches nordiques tient à l'extraordinaire diversité des activités de nos trente-cinq universités membres. Ses points faibles découlent de la balkanisation des efforts déployés (cf. votre document de travail et le rapport de M. Symons paru en 1984), ce qui est évident à la lecture des paragraphes précédents. Les universités ont établi l'AUCEN il y a près de dix ans pour résoudre ce problème. Il nous faut rédiger plusieurs lignes pour exposer les points forts du Canada dans ce domaine de l'enseignement et de la recherche; mais, au moins, aujourd'hui, il y a quelqu'un pour le faire. Bien entendu les connaissances nécessaires pour donner un aperçu des points forts nous permettent également de cerner les points faibles.

Il doit certainement y avoir des dizaines, sinon des centaines, d'organisations comme l'AUCEN, dont l'objectif est de tirer le meilleur parti possible des avantages et inconvénients de la Confédération pour l'avancement de la recherche et de l'enseignement. Toutefois, notre organisation se distingue nettement de la majorité d'entre elles parce qu'elle s'attache non seulement à un sous-ensemble de connaissances, mais aussi à une région distincte et très étendue du pays et du globe. Nous ne prétendons pas que les sciences et la technologie dans le Nord sont uniques mais plutôt que les conditions humaines et physiques qui règnent dans cette région sont assez différentes pour mériter une attention et une organisation spéciales. Ainsi, nous croyons que les scientifiques travaillant dans le Nord doivent souvent adopter une perspective multidisciplinaire et démontrer une affinité particulière pour les sciences humaines, de même que des principes éthiques spéciaux.

Tout en considérant les sciences comme "universelles", nous concevons aisément qu'il faille concentrer les énergies nationales sur des aspects précis pour en assurer l'avancement. L'intérêt que nous portons au Nord nous aide également à percevoir le concept d'une technologie aux dimensions typiquement canadiennes.

D'un point de vue plus terre-à-terre, nous estimons contribuer à la bonne gestion du Nord canadien, c'est-à-dire du nord des provinces et des Territoires dont les ressources scientifiques sont à l'heure actuelle très limitées, et donc à la bonne gestion de la majorité du territoire national. Ni l'un ni l'autre des territoires n'a d'université, bien qu'on y trouve les fondements d'instituts scientifiques.

Étant donné ses engagements dans les Territoires, l'AUCEN s'estime un organisme vraiment "national", au sens où vous l'entendez dans votre document de travail, et préconise une politique nationale des sciences et de la technologie.

Nous percevons le Canada comme une nation qui, après avoir existé pendant plus d'un siècle en confédération, a à tout le moins appris à faire face aux réalités de la vie dans le Sud (que beaucoup d'étrangers considèrent le nord, bien entendu), mais qui n'a pas encore accepté sa responsabilité nationale et mondiale dans le Nord. Chaque Canadien a la responsabilité de plus de biens fonciers que sa contrepartie de presque tout autre pays du monde, mais la majeure partie de ces biens sont dits situés dans le "Nord", d'après la plupart des systèmes de repères. Nous nous soustrairions à la responsabilité qui nous incombe, à titre de riche pays industrialisé, si nous omettions de tenir compte de ce fait au moment d'affecter une bonne part de nos énergies scientifiques et technologiques. Nous maintenons en outre, comme le fait M. T.H.B. Symons (1973), qu'une telle concentration augmentera la valeur de la contribution canadienne à la science universelle, puisqu'il est en générale plus sain de résoudre les problèmes qui nous concernent directement. Les Canadiens sont plus susceptibles de contribuer à l'avancement de la science par l'étude des ours polaires que par celle des chameaux. Ce fait est encore plus évident dans le domaine de la technologie que dans celui de la science. La nature du Canada présente à la fois des débouchés (les ours polaires, par exemple) et des obligations (les ours polaires également).

Le Nord constitue une responsabilité nationale. Nous le devons aux habitants du Nord et à la collectivité mondiale d'acquérir des compétences "nordiques" dans les domaines des sciences et de la technologie. Dans la mesure où les sciences et la technologie du "Nord" se résume aux sciences et à la technologie des régions froides, l'acquisition de telles compétences est d'ailleurs à l'avantage d'un pays comme le nôtre.

De plus, nous sommes d'avis que le Nord canadien est un bien que le Canada détient en "fidéicommis" pour la collectivité mondiale. Il nous incombe, en tant que nation assez peu nombreuse administrant une grande partie des terres et des mers du globe, de profiter au maximum des sciences et techniques polaires mises au point à l'étranger. Non seulement devons-nous faire connaître les résultats de nos travaux, nous devons également nous servir le plus possible des énormes quantités de renseignements accumulés par

d'autres pays, au sujet du pôle nord et du pôle sud. À l'heure actuelle, nous n'avons aucun moyen systématique national de puiser dans ces renseignements. Nous n'avons ni orientation ni réseau pour rassembler nos propres données sur le Nord et nous n'avons pas non plus de centre national capable de canaliser les résultats des travaux des autres pays au sujet des régions polaires.

L'AUCEN est une organisation universitaire nationale et, bien que nous travaillons en étroite en collaboration avec les groupes autochtones, le secteur privé, les gouvernements provinciaux, le gouvernement fédéral et les territoires, nous ne pouvons pas prétendre représenter toutes les sciences et la technologie "nationales" en ce qui concerne le Nord. Dans notre mémoire sur l'Institut polaire national (présenté à M. David Crombie en 1986), nous avons, exprimé certaines préoccupations à l'égard de la circulation de l'information parmi ces différents secteurs de la vie nationale dans le Nord. De même, bien que nous suivons de toujours plus près l'évolution internationale des affaires polaires, nous n'avons pas les moyens d'en être les responsables à l'échelle nationale.

L'Arctic Science Act, passée par le Congrès américain en 1984 (annexe B), offre un exemple intéressant d'une approche pratique aux sciences et à la technologie dans le Nord.

La Loi institue un plan de recherche arctique (Arctic Research Plan) auquel tous les organismes fédéraux américains devront souscrire. La National Science Foundation est l'organisme directeur chargé d'élaborer le plan d'ici au mois de juin 1987.

D'après le document de fond (cf. Polar Research Board, 1985), les domaines auxquels il faut s'intéresser particulièrement sont : la physique de la haute atmosphère et de l'espace extra-atmosphérique, les sciences atmosphériques, l'océanographie physique et chimique, la biologie marine, la glaciologie et l'hydrologie, la géologie et la géophysique, les recherches sur le pergélisol, l'ingénierie dans l'Arctique, la biologie terrestre et des eaux douces, la médecine et la biologie humaine, la recherche sociale et culturelle et l'économie.

La conception d'un réseau national de données sur l'Arctique à l'usage des États-Unis (cf. Sokolov, 1985) constitue une part extrêmement importante du plan. L'objet du réseau est d'accroître l'efficacité de la recherche et de faciliter la prise de décision, en aidant l'utilisateur, peu importe l'endroit où il se trouve aux États-Unis, à vérifier s'il existe des données sur un sujet particulier concernant l'Arctique et, le cas échéant, en lui indiquant comment et où se procurer ces données. Le réseau doit convenir à toutes sortes d'usagers, non pas seulement à des chercheurs. Il comprendra des données qu'on trouve habituellement dans les bibliothèques et des données d'autres genres (numériques, par exemple).

Il s'agit en fait d'intégrer les systèmes d'information existants en un tout, en renforçant les points faibles et comblant les lacunes au besoin. Voilà d'ailleurs les avantages stratégiques (pour les sciences et la technologie, par exemple) d'un exercice de la sorte.

Le Canada a un nombre étonnamment élevé de très bons systèmes d'information sur les régions polaires, qui sont regroupés assez librement sous l'égide du Northern and Offshore Information Resources Group (cf. AUCEN, 1986 [en préparation]). Toutefois, sous ce rapport également, nous subissons les effets positifs et négatifs de la balkanisation. Aucun de ces systèmes ne peut être tenu pour complet, et les efforts en vue de les relier ont à peine commencé. Bien entendu, sous certains rapports, la situation est plus simple aux États-Unis, car les Américains ont une seule grande juridiction pour les travaux relatifs à l'Arctique, nommément l'Alaska. Tous les autres travaux polaires y compris les énormes projets menés dans l'Antarctique, sont essentiellement de caractère "national". De plus, la Library of Congress a un mandat tout à fait universel, de sorte qu'il lui incombe automatiquement de recueillir et de distribuer les données émanant de l'U.R.S.S. au sujet de l'Arctique et de l'Antarctique. Par contraste, les Territoires et sept des dix provinces, ainsi que tous les principaux ministères fédéraux, participent directement aux activités concernant le "Nord" canadien. De plus, nos bibliothèques nationales ont un mandat très limité en ce qui concerne les travaux polaires internationaux.

L'Arctic Science Act peut être perçue comme un effort visant à compenser les énormes ressources que les États-Unis ont consacrées à l'Antarctique au cours des dernières décennies. Il s'agit d'un effort délibéré de rapatrier la science des régions froides dans l'hémisphère nord. Les États-Unis et l'U.R.S.S., qui sont les protagonistes de cette discipline, ont mis beaucoup d'énergie dans l'étude de l'Antarctique au cours des dernières décennies. De fait, l'Antarctique est, sous plusieurs rapports, la principale source des sciences et de la technologie des régions froides aujourd'hui. Le Canada est le seul pays industrialisé qui n'a pas encore signé le traité de l'Antarctique.

Étant donné ses compétences et ses intérêts très divers dans le Nord, le Canada a bien besoin d'un système d'information sur le Nord, qui soit vraiment national. Il bénéficierait d'ailleurs plus que la plupart des autres pays de l'intégration des systèmes existant à l'échelle internationale. Or il n'est pas impossible que nous devenions le pivot d'un tel système, si nous parvenons à régler nos problèmes internes de balkanisation. Qui sait, à ce plan comme à d'autres, peut-être l'existence du Nord ou notre responsabilité à son égard nous inciteront-elles à prendre une initiative qui bénéficierait à toute la nation? Peut-être cette initiative pourrait-elle porter d'abord sur les sciences et la technologie?

Votre document de travail traite de l'enseignement des sciences. L'AUCEN, comme les autres organisations universitaires, s'intéresse beaucoup à la fois à l'enseignement et à la recherche, dans la mesure où on peut distinguer ces deux domaines. Bien que, au cours des premières années de notre existence, nous nous soyons peut-être attardé davantage à la quantité des études nordiques, aujourd'hui, nous nous préoccupons beaucoup de la qualité de ces études. Il est certain que les efforts d'une petite association sont forcément de portée assez limitée. Toutefois, nous avons essayé d'encourager l'intérêt exprimé pour les thèmes concernant le Nord dans les écoles, les collèges et les universités. Des dizaines de milliers d'étudiants universitaires font aujourd'hui des "études nordiques", à un moment donné pendant leurs cours. Nous estimons qu'il est important que les étudiants en sciences et technologie soient non seulement mis en présence de la teneur "nordique" de leur propre discipline, mais aussi des travaux concernant le Nord effectués dans d'autres disciplines, scientifiques ou non. Il n'est simplement pas possible aujourd'hui de faire de bonnes recherches scientifiques ou d'utiliser la science, de façon valable, dans le Nord sans tenir compte des caractéristiques sociales, politiques et écologiques qui caractérisent les régions polaires.

À titre d'indication de l'envergure actuelle de l'activité universitaire dans le Nord, disons que plus de trois cents étudiants universitaires entreprennent chaque année des recherches plus ou moins autonomes dans le Nord, dans le cadre d'un seul programme de subventions. Il s'agit du Programme de subventions à la formation scientifique dans le Nord, administré par le ministère des Affaires indiennes et du Nord, qui l'a mis sur pied dans le but exprès de soutenir la formation de jeunes savants (pour plus de détails, cf. le vol. 5, n° 4 de Northline/Point Nord, publié en octobre 1985, et les rapports du Programme.) Nous estimons que le nombre d'étudiants universitaires canadiens et étrangers qui travaillent, d'une façon ou d'une autre, dans le Nord canadien, équivaut facilement au triple des étudiants inscrits au programme. Par ailleurs, comme nous le disions auparavant, nous organisons à l'heure actuelle, une conférence nationale des étudiants en études nordiques, afin de repérer les meilleurs de ces jeunes savants et d'établir des réseaux personnels leur permettant de communiquer entre eux.

Nous aimerions, sauf votre respect, faire quelques observations concernant l'enseignement des sciences ou plus précisément concernant la science et l'enseignement dans le Nord. Bien que le nord des provinces soit chaque jour mieux desservi par les collèges et universités, les Territoires du Nord-ouest et le Yukon ont à peine jeté les fondements de leurs systèmes scolaires, plus particulièrement dans le domaine de la science. Pourtant, ces territoires sont déjà le point de mire de recherches très considérables, tant dans le domaine des sciences physiques que dans celui des sciences sociales. Le secteur privé, le gouvernement et les universités y mènent tous de très grands programmes de recherche.

Nous serions heureux de faire tout ce que nous pouvons pour orienter les ressources scientifiques dans le Nord, en servant, par exemple, de force cohésive entre les écoles secondaires, l'enseignement par satellite et les autres programmes, les scientifiques et les étudiants visitant la région, les fonctionnaires fédéraux et territoriaux chargés du domaine des sciences, les travailleurs scientifiques du secteur privé, les stations sur le terrain, etc. Ici, comme ailleurs, la collectivité scientifique déborde la sphère des chercheurs professionnels et des directeurs scientifiques. Or, nous ne pouvons nous permettre de gaspiller de telles ressources au Canada et encore moins dans les régions du Nord où la population est clairsemée.

Lors de notre dernière assemblée annuelle à Yellowknife, il nous a été signalé à maintes reprises que les habitants du Nord veulent et, de fait, insistent pour que, toutes les activités scientifiques menées sur leur territoire comportent désormais un élément d'enseignement. Ces gens veulent être mis au courant du détail des projets avant que ceux-ci ne débutent, être tenus au courant de l'avancement des travaux entrepris et en recevoir les résultats sous forme de publications, une fois les projets terminés. Ils veulent participer aux projets scientifiques de toutes les façons possibles. Il est intéressant de concilier ce point de vue et la perspective nationale énoncée dans votre document de travail. Pouvons-nous nous permettre de ne pas profiter pleinement des travaux entrepris au Canada par des scientifiques étrangers? Tirons-nous pleinement avantage des travaux de nos propres scientifiques, au plan éducatif?

Les habitants du Nord, qui sont remarquablement conscients de la portée mondiale de leurs préoccupations (au sujet des mammifères migrateurs, des effets des changements écologiques sur le pergélisol et sur les glaces de mer, par exemple) veulent être tenus au courant du "savoir-faire" national et international. Ainsi, les habitants du delta du Mackenzie veulent connaître les résultats des travaux concernant le caribou au Québec et en U.R.S.S. Voilà certainement un autre message d'intérêt pour la nation entière.

Il n'y a pas de doute que les habitants du Nord peuvent se faire leur propre porte-parole. Si nous soulevons ces points, c'est en tant qu'association universitaire qui leur est particulièrement obligée et en tant qu'association réunissant un grand nombre d'étudiants et de professeurs s'intéressant au Nord.

Nous comptons également dans nos universités un grand nombre d'étudiants et de professeurs autochtones, venant ou non du Nord. Les Territoires du Nord-ouest, région qui nous intéresse particulièrement, constituent la dernière juridiction d'Amérique du Nord où les autochtones sont nettement en majorité. Or les besoins particuliers des peuples autochtones et leurs contributions au savoir nous ont été signalés à maintes reprises, lors de nos assemblées à Yellowknife et ailleurs.

Pour ce qui est des sciences et de la technologie, nous aimerions souligner deux grands points. D'abord, il faut continuer de faire des efforts particuliers pour améliorer l'enseignement des sciences dans les collectivités autochtones. Les préoccupations de ces collectivités à l'égard de la médecine et de

l'écologie témoignent bien du réel besoin qu'elles ressentent. Ensuite, le Canada doit vraiment s'efforcer de profiter des connaissances traditionnelles (en l'occurence en sciences et en technologie) des divers groupes autochtones. Certains travaux d'ethnobotanie et de médecine et des recherches écologiques supposant la collaboration de chasseurs et trappeurs avec des scientifiques traditionnels ont déjà illustré la valeur de cette approche. Nous recommandons instamment que le Canada ne laisse pas cette ressource pour compte, particulièrement dans le Nord.

Ainsi, Monsieur le ministre, nous préconisons que l'élaboration d'une politique nationale des sciences et de la technologie doit reconnaître, implicitement et explicitement, que le Canada est un pays polaire et que ses sciences et sa technologie doivent refléter cette réalité. Cela constituerait par ailleurs une attestation expresse de notre responsabilité mondiale et serait dans l'intérêt de la nation.

L'existence du Nord canadien a déjà eu pour effet de rassembler des savants de disciplines variées, au sein de certaines universités et de l'AUCEN. Peut-être pourrait-elle maintenant donner une orientation utile et tangible à l'établissement d'une stratégie nationale à l'égard de l'enseignement supérieur et de la recherche, ce qui, à long terme, constitue le seul fondement valable d'une politique nationale des sciences et de la technologie.

Le directeur général,

W. Peter Adams
Le 13 mai 1986

S. 373

Arctic Policy Act only

Ninety-eighth Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the twenty-third day of January, one thousand nine hundred and eighty-four

An Act

To provide for a comprehensive national policy dealing with national research needs and objectives in the Arctic, for a National Critical Materials Council, for development of a continuing and comprehensive national materials policy, for programs necessary to carry out that policy, including Federal programs of advanced materials research and technology, and for innovation in basic materials industries, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—ARCTIC RESEARCH AND POLICY

SHORT TITLE

SEC. 101. This title may be cited as the "Arctic Research and Policy Act of 1984".

FINDINGS AND PURPOSES

SEC. 102. (a) The Congress finds and declares that—

(1) the Arctic, onshore and offshore, contains vital energy resources that can reduce the Nation's dependence on foreign oil and improve the national balance of payments;

(2) as the Nation's only common border with the Soviet Union, the Arctic is critical to national defense;

(3) the renewable resources of the Arctic, specifically fish and other seafood, represent one of the Nation's greatest commercial assets;

(4) Arctic conditions directly affect global weather patterns and must be understood in order to promote better agricultural management throughout the United States;

(5) industrial pollution not originating in the Arctic region collects in the polar air mass, has the potential to disrupt global weather patterns, and must be controlled through international cooperation and consultation;

(6) the Arctic is a natural laboratory for research into human health and adaptation, physical and psychological, to climates of extreme cold and isolation and may provide information crucial for future defense needs;

(7) atmospheric conditions peculiar to the Arctic make the Arctic a unique testing ground for research into high latitude communications, which is likely to be crucial for future defense needs;

(8) Arctic marine technology is critical to cost-effective recovery and transportation of energy resources and to the national defense;

(9) the United States has important security, economic, and environmental interests in developing and maintaining a fleet of icebreaking vessels capable of operating effectively in the heavy ice regions of the Arctic;

(10) most Arctic-rim countries, particularly the Soviet Union, possess Arctic technologies far more advanced than those currently available in the United States;

(11) Federal Arctic research is fragmented and uncoordinated at the present time, leading to the neglect of certain areas of research and to unnecessary duplication of effort in other areas of research;

(12) improved logistical coordination and support for Arctic research and better dissemination of research data and information is necessary to increase the efficiency and utility of national Arctic research efforts;

(13) a comprehensive national policy and program plan to organize and fund currently neglected scientific research with respect to the Arctic is necessary to fulfill national objectives in Arctic research;

(14) the Federal Government, in cooperation with State and local governments, should focus its efforts on the collection and characterization of basic data related to biological, materials, geophysical, social, and behavioral phenomena in the Arctic;

(15) research into the long-range health, environmental, and social effects of development in the Arctic is necessary to mitigate the adverse consequences of that development to the land and its residents;

(16) Arctic research expands knowledge of the Arctic, which can enhance the lives of Arctic residents, increase opportunities for international cooperation among Arctic-rim countries, and facilitate the formulation of national policy for the Arctic; and

(17) the Alaskan Arctic provides an essential habitat for marine mammals, migratory waterfowl, and other forms of wildlife which are important to the Nation and which are essential to Arctic residents.

(b) The purposes of this title are—

(1) to establish national policy, priorities, and goals and to provide a Federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences;

(2) to establish an Arctic Research Commission to promote Arctic research and to recommend Arctic research policy;

(3) to designate the National Science Foundation as the lead agency responsible for implementing Arctic research policy; and

(4) to establish an Interagency Arctic Research Policy Committee to develop a national Arctic research policy and a five year plan to implement that policy.

ARCTIC RESEARCH COMMISSION

Sec. 103. (a) The President shall establish an Arctic Research Commission (hereafter referred to as the "Commission").

(b)(1) The Commission shall be composed of five members appointed by the President, with the Director of the National Science Foundation serving as a nonvoting, ex officio member. The members appointed by the President shall include—

(A) three members appointed from among individuals from academic or other research institutions with expertise in areas of research relating to the Arctic, including the physical, biological, health, environmental, social, and behavioral sciences;

(B) one member appointed from among indigenous residents of the Arctic who are representative of the needs and interests of Arctic residents and who live in areas directly affected by Arctic resource development; and

(C) one member appointed from among individuals familiar with the Arctic and representative of the needs and interests of private industry undertaking resource development in the Arctic.

(2) The President shall designate one of the appointed members of the Commission to be chairperson of the Commission.

(c)(1) Except as provided in paragraph (2) of this subsection, the term of office of each member of the Commission appointed under subsection (b)(1) shall be four years.

(2) Of the members of the Commission originally appointed under subsection (b)(1)—

(A) one shall be appointed for a term of two years;

(B) two shall be appointed for a term of three years; and

(C) two shall be appointed for a term of four years.

(3) Any vacancy occurring in the membership of the Commission shall be filled, after notice of the vacancy is published in the Federal Register, in the manner provided by the preceding provisions of this section, for the remainder of the unexpired term.

(4) A member may serve after the expiration of the member's term of office until the President appoints a successor.

(5) A member may serve consecutive terms beyond the member's original appointment.

(d)(1) Members of the Commission may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. A member of the Commission not presently employed for compensation shall be compensated at a rate equal to the daily equivalent of the rate for GS-16 of the General Schedule under section 5332 of title 5, United States Code, for each day the member is engaged in the actual performance of his duties as a member of the Commission, not to exceed 90 days of service each year. Except for the purposes of chapter 81 of title 5 (relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims), a member of the Commission shall not be considered an employee of the United States for any purpose.

(2) The Commission shall meet at the call of its Chairman or a majority of its members.

(3) Each Federal agency referred to in section 107(b) may designate a representative to participate as an observer with the Commission. These representatives shall report to and advise the Commission on the activities relating to Arctic research of their agencies.

(4) The Commission shall conduct at least one public meeting in the State of Alaska annually.

DUTIES OF COMMISSION

SEC. 104. (a) The Commission shall—

(1) develop and recommend an integrated national Arctic research policy;

(2) in cooperation with the Interagency Arctic Research Policy Committee established under section 107, assist in establishing a national Arctic research program plan to implement the

(3) facilitate cooperation between the Federal Government and State and local governments with respect to Arctic research;

(4) review Federal research programs in the Arctic and suggest improvements in coordination among programs;

(5) recommend methods to improve logistical planning and support for Arctic research as may be appropriate and in accordance with the findings and purposes of this title;

(6) suggest methods for improving efficient sharing and dissemination of data and information on the Arctic among interested public and private institutions;

(7) offer other recommendations and advice to the Interagency Committee established under section 107 as it may find appropriate; and

(8) cooperate with the Governor of the State of Alaska and with agencies and organizations of that State which the Governor may designate with respect to the formulation of Arctic research policy.

(b) Not later than January 31 of each year, the Commission shall—

(1) publish a statement of goals and objectives with respect to Arctic research to guide the Interagency Committee established under section 107 in the performance of its duties; and

(2) submit to the President and to the Congress a report describing the activities and accomplishments of the Commission during the immediately preceding fiscal year.

COOPERATION WITH THE COMMISSION

SEC. 105. (a)(1) The Commission may acquire from the head of any Federal agency unclassified data, reports, and other nonproprietary information with respect to Arctic research in the possession of the agency which the Commission considers useful in the discharge of its duties.

(2) Each agency shall cooperate with the Commission and furnish all data, reports, and other information requested by the Commission to the extent permitted by law; except that no agency need furnish any information which it is permitted to withhold under section 552 of title 5, United States Code.

(b) With the consent of the appropriate agency head, the Commission may utilize the facilities and services of any Federal agency to the extent that the facilities and services are needed for the establishment and development of an Arctic research policy, upon reimbursement to be agreed upon by the Commission and the agency head and taking every feasible step to avoid duplication of effort.

(c) All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research.

ADMINISTRATION OF THE COMMISSION

SEC. 106. The Commission may—

(1) in accordance with the civil service laws and subchapter III of chapter 53 of title 5, United States Code, appoint and fix the compensation of an Executive Director and necessary additional staff personnel, but not to exceed a total of seven compensated personnel;

(2) procure temporary and intermittent services as authorized by section 3109 of title 5, United States Code;

(3) enter into contracts and procure supplies, services, and personal property; and

(4) enter into agreements with the General Services Administration for the procurement of necessary financial and administrative services, for which payment shall be made by reimbursement from funds of the Commission in amounts to be agreed upon by the Commission and the Administrator of the General Services Administration.

LEAD AGENCY AND INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

SEC. 107. (a) The National Science Foundation is designated as the lead agency responsible for implementing Arctic research policy, and the Director of the National Science Foundation shall insure that the requirements of section 108 are fulfilled.

(b)(1) The President shall establish an Interagency Arctic Research Policy Committee (hereinafter referred to as the "Interagency Committee").

(2) The Interagency Committee shall be composed of representatives of the following Federal agencies or offices:

(A) the National Science Foundation;

(B) the Department of Commerce;

(C) the Department of Defense;

(D) the Department of Energy;

(E) the Department of the Interior;

(F) the Department of State;

(G) the Department of Transportation;

(H) the Department of Health and Human Services;

(I) the National Aeronautics and Space Administration;

(J) the Environmental Protection Agency; and

(K) any other agency or office deemed appropriate.

(3) The representative of the National Science Foundation shall serve as the Chairperson of the Interagency Committee.

DUTIES OF THE INTERAGENCY COMMITTEE

SEC. 108. (a) The Interagency Committee shall—

(1) survey Arctic research conducted by Federal, State, and local agencies, universities, and other public and private institutions to help determine priorities for future Arctic research, including natural resources and materials, physical and biological sciences, and social and behavioral sciences;

(2) work with the Commission to develop and establish an integrated national Arctic research policy that will guide Federal agencies in developing and implementing their research programs in the Arctic;

(3) consult with the Commission on—

(A) the development of the national Arctic research policy and the 5-year plan implementing the policy;

(B) Arctic research programs of Federal agencies;

(C) recommendations of the Commission on future Arctic research; and

(D) guidelines for Federal agencies for awarding and administering Arctic research grants;

(4) develop a 5-year plan to implement the national policy, as provided for in section 109;

(5) provide the necessary coordination, data, and assistance for the preparation of a single integrated, coherent, and multi-agency budget request for Arctic research as provided for in section 110;

(6) facilitate cooperation between the Federal Government and State and local governments in Arctic research, and recommend the undertaking of neglected areas of research in accordance with the findings and purposes of this title;

(7) coordinate and promote cooperative Arctic scientific research programs with other nations, subject to the foreign policy guidance of the Secretary of State;

(8) cooperate with the Governor of the State of Alaska in fulfilling its responsibilities under this title;

(9) promote Federal interagency coordination of all Arctic research activities, including—

(A) logistical planning and coordination; and

(B) the sharing of data and information associated with Arctic research, subject to section 552 of title 5, United States Code; and

(10) provide public notice of its meetings and an opportunity for the public to participate in the development and implementation of national Arctic research policy.

(b) Not later than January 31, 1986, and biennially thereafter, the Interagency Committee shall submit to the Congress through the President, a brief, concise report containing—

(1) a statement of the activities and accomplishments of the Interagency Committee since its last report; and

(2) a description of the activities of the Commission, detailing with particularity the recommendations of the Commission with respect to Federal activities in Arctic research.

5-YEAR ARCTIC RESEARCH PLAN

Sec. 109. (a) The Interagency Committee, in consultation with the Commission, the Governor of the State of Alaska, the residents of the Arctic, the private sector, and public interest groups, shall prepare a comprehensive 5-year program plan (hereinafter referred to as the "Plan") for the overall Federal effort in Arctic research. The Plan shall be prepared and submitted to the President for transmittal to the Congress within one year after the enactment of this Act and shall be revised biennially thereafter.

(b) The Plan shall contain but need not be limited to the following elements:

(1) an assessment of national needs and problems regarding the Arctic and the research necessary to address those needs or problems;

(2) a statement of the goals and objectives of the Interagency Committee for national Arctic research;

(3) a detailed listing of all existing Federal programs relating to Arctic research, including the existing goals, funding levels for each of the 5 following fiscal years, and the funds currently being expended to conduct the programs;

(4) recommendations for necessary program changes and other proposals to meet the requirements of the policy and goals

as set forth by the Commission and in the Plan as currently in effect; and

(5) a description of the actions taken by the Interagency Committee to coordinate the budget review process in order to ensure interagency coordination and cooperation in (A) carrying out Federal Arctic research programs, and (B) eliminating unnecessary duplication of effort among these programs.

COORDINATION AND REVIEW OF BUDGET REQUESTS

SEC. 110. (a) The Office of Science and Technology Policy shall—

(1) review all agency and department budget requests related to the Arctic transmitted pursuant to section 108(a)(5), in accordance with the national Arctic research policy and the 5-year program under section 108(a)(2) and section 109, respectively; and

(2) consult closely with the Interagency Committee and the Commission to guide the Office of Science and Technology Policy's efforts.

(b)(1) The Office of Management and Budget shall consider all Federal agency requests for research related to the Arctic as one integrated, coherent, and multiagency request which shall be reviewed by the Office of Management and Budget prior to submission of the President's annual budget request for its adherence to the Plan. The Commission shall, after submission of the President's annual budget request, review the request and report to Congress on adherence to the Plan.

(2) The Office of Management and Budget shall seek to facilitate planning for the design, procurement, maintenance, deployment, and operations of icebreakers needed to provide a platform for Arctic research by allocating all funds necessary to support icebreaking operations, except for recurring incremental costs associated with specific projects, to the Coast Guard.

AUTHORIZATION OF APPROPRIATIONS; NEW SPENDING AUTHORITY

SEC. 111. (a) There are authorized to be appropriated such sums as may be necessary for carrying out this title.

(b) Any new spending authority (within the meaning of section 401 of the Congressional Budget Act of 1974) which is provided under this title shall be effective for any fiscal year only to such extent or in such amounts as may be provided in appropriation Acts.

DEFINITION

SEC. 112. As used in this title, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.

TITLE II—NATIONAL CRITICAL MATERIALS ACT OF 1984

SHORT TITLE

SEC. 201. This title may be cited as the "National Critical Materials Act of 1984".

Réponses aux questions posées dans le document de travail
(Les moyens de notre avenir, MEST, le 22 avril 1986)
en complément du mémoire de l'AUCEN

DÉVELOPPER ET ACQUÉRIR DE NOUVELLES CONNAISSANCES

1a. Le Canada retire-t-il le maximum d'avantages des fonds consacrés à la recherche universitaire? Dans la négative, quelle mesure pourrait-on prendre pour améliorer la situation?

Nous avançons dans notre mémoire qu'une meilleure collaboration et coordination de toutes les parties intéressées aux sciences et à la technologie dans le Nord est chose souhaitable et mènerait à un emploi plus efficace des ressources existantes. Nous sommes d'avis que le rôle joué par l'AUCEN auprès des universités a déjà permis un meilleur emploi des ressources. Ainsi, nous nous sommes efforcé de faire mieux connaître les stations aménagées dans le Nord (pour diminuer le coût de la vie des chercheurs, maximiser l'emploi des aéronefs véhiculant des groupes, etc.) et d'améliorer l'évaluation des programmes de subventions existants. Fondamentalement, nous sommes une organisation "d'entraide"et, à long terme, l'entraide assure un emploi efficace des fonds (cf. point 6 ci-dessous).

Les efforts de l'AUCEN perdent de l'efficacité lorsque celle-ci sort du champ de sa collectivité universitaire.

1b. Si de nouveaux fonds devenaient disponibles, devraient-ils être utilisés pour la recherche universitaire? Dans l'affirmative, de quelle façon devraient-ils être dépensés pour offrir le maximum d'avantages au pays?

Nous croyons que les universités constituent un véhicule particulièrement utile pour les sciences et la technologie dans le Nord et qu'elles devraient par conséquent être d'importants bénéficiaires de tous nouveaux fonds disponibles. De bien des façons, les universités font le lien entre le secteur privé, les gouvernements et les habitants du Nord.

Néanmoins, nous regrettons énormément que le projet d'aménagement d'une installation de recherche et d'ingénierie des régions froides ("CNRC ouest") à Edmonton ait été contremandé. L'effort national à l'égard des divers aspects de l'ingénierie de la météorologie des régions froides est à l'heure actuelle très limitée et manque d'orientation : il mérite un appui renouvelé.

Nous croyons également que les sciences et la technologie marines, selon leur acceptation plus générale, et, dans une moindre mesure, leur équivalent en ce qui concerne les eaux douces, méritent une attention particulière à l'échelle nationale, surtout dans le Nord. Les exigences de l'agrandissement de la zone économique au large des côtes et des dispositions du droit de la mer au sujet des eaux couvertes de glace, les répercussions de la souveraineté canadienne dans l'Arctique au plan des transports et de l'environnement, ainsi que la subsistance et les autres besoins des peuples autochtones ont tous créé des besoins qu'on ne peut satisfaire à l'heure actuelle.

De plus, et encore une fois surtout dans le Nord, il faut aussi étudier les répercussions sociales et économiques des sciences et de la technologie avec beaucoup plus d'attention. Nous englobons ici les observations présentées dans notre mémoire au sujet de la science aborigène. En effet, les scientifiques ne sauraient, à l'avenir, travailler de façon efficace et éthique sans tenir pleinement compte de ces répercussions.

1c. Êtes-vous satisfait des progrès accomplis vers une collaboration entre les universités et l'industrie dans le domaine des sciences et de la technologie? Devrions-nous encourager davantage cette collaboration? Dans l'affirmative, comment pouvons-nous favoriser l'établissement de meilleurs liens entre le secteur privé et les universités?

La plupart des chercheurs universitaires, des ingénieurs et des directeurs scientifiques du Nord sont plus conscients des avantages de la collaboration avec l'industrie (et avec le gouvernement) que leurs collègues du Sud. L'AUCEN a délibérément essayé de "s'associer" à l'industrie et y a réussi dans une certaine mesure par l'organisation, avec celle-ci, de symposiums et d'ateliers productifs, de programmes de bourses d'études, etc. Nous signalons à nouveau que la participation du public ("groupes d'utilisateurs") constitue un élément important des rapports entre l'université et l'industrie (ou le gouvernement) dans le domaine des sciences et de la technologie.

1d. Comment votre organisme peut-il aider le Canada à exploiter son capital intellectuel pour qu'il puisse être appliqué à ses besoins? Pour que le Canada puisse acquérir de nouvelles connaissances? Dans la formation de personnel hautement qualifié?

Nous aidons déjà, et, moyennant un appui financier supplémentaire, pourrions aider davantage, grâce à nos fonctions "d'entraide" qui accroissent la collaboration, améliorent les échanges de connaissances, rendent la diffusion de connaissances plus efficace, encouragent une bonne formation, etc., etc. (cf. point 6 ci-dessous). Par exemple, notre conférence nationale des étudiants, qui se tiendra en novembre prochain, constitue un essai délibéré d'amélioration qualitative, après plusieurs années d'effort axé (par nécessité) sur la quantité.

Il serait très souhaitable de pousser ces activités encore plus loin dans le secteur extra-universitaire.

2a. Le Canada retire-t-il le maximum d'avantages des fonds consacrés aux <u>laboratoires gouvernementaux</u>? Dans la négative, quelles mesures pourrait-on prendre pour améliorer la situation?

Sur ce point, se reporter aux observations (cf. point 1b) faites au sujet de la recherche et de l'ingénierie relatives à la météorologie des régions froides. Le CNRC a joué un rôle d'importance primordiale à ce plan des sciences et de la technologie. L'envergure et le coût de certains genres de projets scientifiques et technologiques dans le Nord (et à l'échelle nationale) exigent la participation directe du gouvernement. Le CNRC devrait donc continuer de recevoir un appui considérable pour ce genre de travail. Il devrait également être encouragé à accroître ses échanges de personnel scientifique avec les universités. D'autres laboratoires fédéraux, tel l'Institut des eaux douces à Winnipeg, l'Institut national de recherches en hydrologie à Saskatoon et l'Institut de dynamique marine à St. John's jouent également un rôle important pour l'avancement des sciences et de la technologie dans le Nord. Nous signalons que chacun de ces instituts est nettement associé à une université -- physiquement ou organisationnellement. Ces associations offrent d'énormes avantages au plan de la formation, ainsi qu'à d'autres points de vue.

On s'efforce de mieux employer les stations fédérales de recherche sur le terrain dans les Territoires. Il faudrait intensifier ces efforts. Les universités, les collèges, les écoles, l'industrie, les groupes autochtones et les autres intéressés pourraient bien être invités à participer.

2b. Si de nouveaux fonds devenaient disponibles, devraient-ils être utilisés pour les laboratoires gouvernementaux? Dans l'affirmative, de quelle façon devraient-ils être dépensés pour offrir le maximum d'avantages au pays?

Se reporter aux points 1b et 2a ci-dessus.

2c. Êtes-vous satisfait des progrès accomplis vers une collaboration entre les gouvernements et l'industrie dans le domaine des sciences et de la technologie? Devrions-nous encourager davantage cette collaboration? Dans l'affirmative, comment pouvons-nous favoriser l'établissement de meilleurs liens entre le secteur privé et les laboratoires gouvernementaux?

Se reporter au point 1c ci-dessus.

Nous devrions peut-être accepter le fait que les gouvernements auront, pendant encore bien des années, un rôle important à jouer dans le Nord. Le Fonds renouvelable pour l'étude de l'environnement, par lequel les entreprises de l'industrie pétrolière mettent leurs ressources en commun en vue de leur administration par une agence fédérale aux fins de la recherche dans le Nord et au large des côtes, pourrait constituer un modèle utile. Entre autres choses, il diminue le double emploi et assure une publication assez rapide des résultats.

3. Comment le Canada pourrait-il retirer plus d'avantages des progrès accomplis à l'échelle internationale dans le domaine des sciences et de la technologie? Élargir son rôle au sein des réseaux internationaux de sciences et de technologie? Mettre les compétences canadiennes au service du développement et de la collaboration à l'échelle internationale? Recruter des scientifiques d'autres pays pour qu'ils partagent leurs connaissances au Canada? Comment mon organisme ou secteur peut-il jouer un plus grand rôle à cet égard?

Nous l'expliquons dans notre mémoire. Il nous est tout simplement impossible d'essayer d'établir une force scientifique et technologique efficace dans le Nord, sans tirer pleinement avantage du très grand nombre de travaux effectués par des étrangers dans les régions polaires, l'Antarctique y compris. Nous n'exploitons pas encore avec efficacité les travaux menés dans le nord du Canada par des ressortissants étrangers.

Il est vraiment nécessaire d'établir un point de contact national concernant les travaux polaires internationaux, plus particulièrement ceux qui sont entrepris par les États-Unis et l'U.R.S.S. À notre avis, les universités devraient participer plus directement aux échanges entre le Canada et l'U.R.S.S.

L'AUCEN a dû consacrer une grande partie de ses efforts à corréler et à orienter les travaux universitaires au Canada. Nous avons (par l'intermédiaire du Colloque sur le patrimoine arctique, de communications avec le Conseil nordique, le Northern Libraries Colloquy et la Conférence circumpolaire inuit et d'échanges avec les instituts polaires de bien des pays) fait des efforts pour améliorer les liens du Canada avec la collectivité scientifique internationale, plus particulièrement au plan universitaire.

Toutefois, nos efforts dans ce domaine sont limités par nos ressources actuelles. Nous avons à peine touché les domaines extra-universitaires.

Il serait extrêmement utile à ce stade de tenir un grand débat national, suivi d'un débat international important, sur les sciences et la technologie dans le Nord. De telles rencontres pourraient mettre en présence l'industrie, le gouvernement, les peuples autochtones et les universités du Canada et de l'étranger.

METTRE DES CONNAISSANCES À PROFIT ET SAISIR DES POSSIBILITÉS

4. Le Canada devrait-il concentrer ses ressources scientifiques et technologiques dans certains secteurs stratégiques de façon à maximiser le rendement? Dans l'affirmative comment devrait-il procéder?

Se reporter au point 1b ci-dessus et à diverses sections de notre mémoire.

Ce doit pourtant être bientôt le moment où il serait avantageux d'évaluer les programmes stratégiques de subventions administrés par les conseils accordant des subventions. Donnent-ils des résultats? A-t-on atteint les objectifs initiaux à leur égard? A-t-on réalisé les attentes initiales?

5. Que peut faire le gouvernement pour garantir que les entreprises canadiennes utilisent les meilleures technologies? Que peut faire votre organisme ou secteur à cet égard?

Nous répétons que, dans le Nord, les gouvernements devront vraisemblablement continuer de jouer un rôle important à l'égard des sciences et de la technologie. Il y va de l'intérêt national aussi bien que de celui du Nord. Nous avons idée que les compagnies canadiennes, encore plus que les universités canadiennes, sont mal informées des grands courants des sciences et de la technologie polaires. Il faut mieux orienter l'effort national (cf. par exemple le point 3 ci-dessus).

6. Que peut faire votre organisme ou secteur pour améliorer les méthodes utilisées pour diffuser les nouvelles technologies? Pour améliorer le transfert des technologies? Pour permettre le développement, la commercialisation, le financement et le marketing dans tous les domaines de notre secteur des affaires?

Bien que reconnaissant que cette question concerne précisément la diffusion des technologies, nous reprenons les observations que nous avons déjà faites au sujet de l'importance de "l'entraide". Le problème n'est pas simple; il ne s'agit pas seulement de produire un nouveau bulletin de nouvelles ou une nouvelle revue ou de monter une campagne publicitaire.

L'AUCEN, par exemple, tient des assemblées annuelles qui réunissent les professeurs de différentes disciplines de trente-cinq universités, ainsi que des membres des secteurs public et privé participant à la vie du Nord et habitant le Nord. Nous organisons des symposiums et des ateliers sur des thèmes choisis (ingénierie nordique : organisation et politique; les sciences sociales dans le Nord; l'enseignement supérieur, la recherche et les systèmes d'information dans le Nord, par exemple). Nous produisons diverses publications (notamment la Liste des spécialistes du Nord dans les universités canadiennes, qui indique le domaine de spécialisation universitaire et régionale de 600 professeurs canadiens, et les Principes d'éthique pour la conduite de recherches dans le Nord). Nous avons des programmes de bourses d'études qui influencent le choix de carrière des étudiants. (Par exemple, la Fiduciaire canadienne d'études nordiques remet des bourses appréciables aux étudiants méritants et des prix spéciaux aux résidants du Nord. Nous administrons également un programme à l'intention des étudiants autochtones qui entreprennent des études supérieures dans des domaines reliés aux affaires.) Nous encourageons les études nordiques par des programmes de conférenciers invités et par la tenue d'une conférence nationale des étudiants. Nous tenons un bureau qui tient lieu de point de chute pour notre réseau d'universités et qui sert de lien avec

le gouvernement, l'industrie et les organismes étrangers exécutant des travaux relatifs aux régions polaires. Notre bureau publie régulièrement un bulletin de nouvelles intitulé Point Nord, qui est tiré à 2 000 exemplaires. Ce sont là des exemples des activités que suppose une entraide efficace dans un domaine universitaire. Or, ces activités touchent divers aspects des sciences et de la technologie, depuis leur enseignement dans les écoles jusqu'à la mise au point et à la distribution de nouveaux produits.

Il n'y a sans doute aucune solution immédiate aux problèmes actuels en ce qui concerne les sciences et la technologie nationales. Le système d'enseignement et de recherche tout entier doit être révisé attentivement. Il faut établir une stratégie d'ensemble. Nous croyons que la Confédération favorise l'enseignement jusqu'à un certain point, au-delà duquel elle perd de l'efficacité, aux dépens des sciences et de la technologie. Toutefois, nous avons de la difficulté à cerner ce point!

7. Quels mécanismes les gouvernements pourraient-ils utiliser pour encourager l'établissement de liens entre, d'une part, les entreprises à technologie et machinerie de pointe et, d'autre part, les secteurs de ressources? Pourquoi ces liens paraissent-ils insuffisants à l'heure actuelle et que peut-on faire pour les renforcer?

Sans commentaire.

8. Comment peut-on encourager l'octroi de capitaux de pré-investissement et comment ces capitaux peuvent-ils être orientés vers les industries à technologie de pointe qui assument des risques élevés? Quel est le rôle des provinces par rapport au rôle du gouvernement fédéral?

Sans commentaire.

S'ADAPTER AUX CHANGEMENTS

9. Que pouvons-nous faire pour aider les Canadiens à faire face aux changements radicaux dans tous les aspects de la vie que provoquera la technologie au cours des deux prochaines décennies? Pour créer un nouvel esprit de collaboration plutôt que d'antagonisme et de rivalité? Garantir que le changement technologique est géré d'une façon intelligente et équitable? Pour sensibiliser davantage le public à l'égard des sciences et de la technologie et pour susciter sa participation dans ce domaine?

Nous répétons qu'à notre avis, la participation d'emblée de ceux qui ne sont pas directement touchés par les sciences et la technologie ou, mieux encore, leur participation continue constitue un élément clé. Nous sommes particulièrement conscients de ce fait dans le Nord, mais il faudrait y accorder une plus grande attention à l'échelle nationale.

Il existe également dans le Nord (comme le démontre l'existence même de notre association) des liens plus étroits entre les sciences physiques, le génie et les autres sciences, comme la médecine, et entre ces sciences et les sciences sociales et les humanités. Les préoccupations soulevées par les effets sociaux et écologiques de l'activité technologique et le stade actuel de l'évolution sociale et politique des Territoires sont des facteurs importants. Ici encore, nous suggérons qu'on peut tirer de la situation dans le Nord des leçons valables pour le Canada entier.

10. Étant donné les forces du marché, le besoin d'établir une "masse critique" et la tendance des entreprises à technologie de pointe à s'implanter dans des agglomérations -- tous des facteurs qui favorisent la concentration --, que devraient faire les gouvernements et d'autres secteurs pour assurer un équilibre entre les régions?

L'"équilibre entre les régions" pose certaines difficultés dans notre cas. Comment un tel concept peut-il s'appliquer au Nord, dans son acception générale ou stricte? La participation soutenue du gouvernement, avec, autant que possible, la collaboration des groupes d'utilisateurs et de l'industrie, constitue vraisemblablement la meilleure solution en ce qui concerne le Nord. Le but de cette participation serait de restreindre le plus possible les problèmes d'une économie marquée par des extrêmes (prospérité ou faillite).

11. Quelles mesures doivent être prises pour favoriser une collaboration conjointe entre les syndicats et le patronat dans l'introduction des nouvelles technologies?

Le Nord semble présenter une situation très particulière du point de vue du rôle du patronat et des syndicats.

APPLIQUER UNE STRATÉGIE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

12. Dans l'élaboration et la mise en oeuvre réussies d'une politique nationale des sciences et de la technologie, quels sont les rôles respectifs du gouvernement fédéral? Des gouvernements provinciaux? Des univertés? Du secteur privé? Des syndicats? Des organismes non gouvernementaux? De votre organisme ou secteur?

Comme nous l'avons déjà dit, le Nord constitue un cas plutôt spécial en ce qui concerne les relations entre le gouvernement et l'industrie. Nous supposons que toute stratégie nationale en tiendra compte. Le secteur privé pourrait, par exemple, jouer un rôle prépondérant dans l'avancement des sciences et de la technologie dans le sud de l'Ontario, tandis que le gouvernement assumerait ce rôle dans le Nord.

Les universités, étant des organismes relativement neutres qui mettent en cause tous les protagonistes des sciences et de la technologie et dont l'influence se fait sentir dans les écoles, se sont taillées une place très particulière dans le domaine des sciences et de la technologie dans le Nord.

13. Que peut faire votre organisme ou secteur pour garantir une coordination et une collaboration soutenues avec tous les autres participants à cet effort? Y a-t-il un mécanisme en particulier qui pourrait rendre cette collaboration plus efficace? Quels objectifs peut-on établir pour orienter la mise en oeuvre de la politique?

Se reporter au point 3 ci-dessus et à notre mémoire.

Nous croyons que l'élaboration d'une stratégie nationale d'enseignement et de recherche constituerait le meilleur fondement d'une politique nationale des sciences et de la technologie. Or cela met en cause tous les secteurs de la vie nationale.

Par ailleurs, les sciences et la technologie dans le Nord pourraient, à notre avis, constituer un pivot valable de cette politique nationale.

14. Avez-vous d'autres suggestions concernant la politique nationale des sciences et de la technologie et le rôle que devraient jouer des secteurs comme le vôtre?

Le nord des provinces est de mieux en mieux servi par les universités et collèges locaux, ainsi que par les programmes de téléenseignement des universités du Sud. Toutefois, malgré la présence très tangible du gouvernement et du secteur privé et malgré les programmes de recherche des universités (tant canadiennes qu'étrangères), aucun des Territoires n'a d'université ni d'institut de recherche bien établi. (L'Institut scientifique des Territoires du Nord-Ouest vient tout juste d'être mis sur pied.) L'Arctic College opère dans les Territoires du Nord-Ouest et le Yukon College prend son essor, mais ni l'un ni l'autre ne possède encore un véritable programme scientifique et technologique. Il y a diverses raisons à cet état de choses, dont certaines sont valables et d'autres pas. Toutefois, si les grands programmes de recherche dans le Nord n'ont pas de retombées, c'est surtout en raison du manque de continuité qui caractérise plusieurs d'entre eux. Toute politique ou stratégie nationale devrait apporter une solution à ce problème.

Il ne faut pas oublier que <u>toutes</u> les autres grandes juridictions de la région circumpolaire ont des universités et des instituts de recherche situés dans le Nord.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

The Development of a National Science and Technology Policy

Association of Provincial Research Organizations
of Canada Inc.

June 8-10, 1986
Winnipeg, Manitoba

The Association of Provincial Research Organizations of Canada Inc. (APRO) and the Development of a National Science and Technology Policy

DEVELOPING AND ACQUIRING NEW KNOWLEDGE

THE UNIVERSITIES

The one and foremost important mandate of our educational system for all post secondary institutions is and should remain the education and training of highly qualified individuals. The accent on the innovation process whether from a scientific, technical or managerial point of view should be emphasized in all education programs so as to build a strong pool of researchers and modify attitudes towards technological changes. Public awareness will never be attained if our future labour and management are not at ease with those changes.

University research is an important aspect of Canada's science and technology challenge although it would be better exploited if targetted. To ensure better use of money available, grants should be awarded in the two (2) following areas of research:
- long-term, free research executed by excellence centers;
- projects with a strong technology transfer orientation.

Although technology transfer is seeked through the University-Industry cooperation system, very little is actually undertaken mostly because of slow response from University to the needs of Small and medium size entreprises(SME). Slow process of obtaining ecomonic results can be easily coped with by large companies. SME's cannot support this. To facilitate transfer of University research to SME, the following recommendations are suggested to achieve better understanding among research suppliers and consumers:
- professors that are engaged in short or mid term research should be discharged from their academic responsabilities and work in close communication with organizations such as PROs which are the closest link to SME's needs;
- strenghten the receiving programs most PROs have already set up for students and professors in sabbatical leave;
- strenghten the University-Industry cooperation by including PROs as catalysts thus putting to good use PRO's experience with both the industry and the academic communities.

GOVERNMENT LABORATORIES

Many resources and skills are already available although sometimes underutilized. Better use of such resources can be obtained through the implementation of policies such as the ones recommended by the "Tehcnology center study" and the "Nielsen report".

Financing would thus be granted to performing excellence centers in accordance to fields of priority. Laboratories that are mandated to render external services to industry, should make sure that their operation is conducted in a business-like model in respect with the existing network of local, regional and provincial establishments.

Better access to government research skills and resources by industry, especially SME, can be brought about by the existing APRO network.

PUTTING KNOWLEDGE TO WORK AND REALIZING OPPORTUNITIES

TECHNOLOGY TRANSFER

Transfer and application of existing state-of-the-art technology, whether from foreign or domestic origin, to SME is already the role of the PROs. The model created by Germany in the establishment of the Fraunhofer-Gesellschaft Institute is ripe for implementation in Canada. APRO members have strong links with local Universities, government laboratories, National Research Council, private consultants, local, regional, national anf international laboratories as well as with industry associations. APRO should continue to be the lead Canadian group in the transfer of technology to SME but it's role should be expanded and officialized to ensure the greatest benefit to the Canadian economy.

To be such a leader, APRO requires governmental financial support for specific core research activities leading to technology transfer. It is a fact that to transfer technology one has to be able to find, understand and adapt it to different needs before thinking of transfer.

TARGETTING SCIENCE AND TECHNOLOGY

All industrialized nations have at some point in time, focussed their efforts in strategic fields of technology. Canada should urgently identify strategic areas of interest, determine the role to be played by each level of Canada's science and technology network in the areas chosen and develop a 5 to 10 year program accordingly.

ADAPTING TO CHANGE

PUBLIC AWARENESS

Public awareness will never be attained if our labour and management are not at ease with technological change Some measures to address this issue include:

- heavy emphasis in the educational system on training and retraining is a must;
- heavy emphasis in our educational programs on the importance of technology;
- a system of rewards and penalties for companies and labour organizations so as to encourage retraining in new technical fields;
- a better communication between management and labour about the introduction of new technologies.

PROs can play an important role in this sensibilization process by its technology demonstration and training activities for SME.

REGIONAL BALANCE

Although market forces strongly favor disparities, government could ensure a better distribution of technological wealth by fostering adequate and efficient communication links within the Science and Technology Community as well as ensuring decentralization of new technological initiatives according to regional and provincial priorities.

PUTTING A NATIONAL SCIENCE AND TECHNOLOGY STRATEGY TO WORK

PROVINCIAL GOVERNMENTS

The role of provincial governments should be to:
- establish provincial/regional priorities;
- provide infrastructural support, including tax incentives and grants, to support those priorities;
- negociate with the federal government concerning national and regional priorities;
- support research and technology transfer of provincial interest;
- adapt educational policies to take technological changes into account.

FEDERAL GOVERNMENT

The role of the federal government should include:
- the establishment, in conjunction with industry and the provinces, of national goals in science and technology with due attention to the issue of available resources and skills;
- the establishment of infrastructural assistance for export marketing, national standards, personnel retraining, science and technology information network as well as incentives through fiscal policies and, where necessary, grants;
- the establishment of policies to lessen future regional disparities;
- the support of research and technology transfer of national interest.

THE PRIVATE SECTOR

All actors of this economic force should participate by:
- precisely articulate their needs for particular science and technology subjects;
- increase their communication with the labour force and motivate training and retraining;
- participate more actively in the risks of technological implementation.

LABOUR

Labour has as important a role to play in this policy as the other partners . In accepting that technological changes will increase , labour must participate by retraining and adaptating the work place to the coming changes.

APRO

The Association of Provincial Research Organizations of Canada Inc. (APRO) groups institutions located in eight provinces, with common goal to satisfy Canadian industrial needs in research and development, technical services and information. Grant aided by provincial administrations, APRO offers infrastructures and professionnal skills accessible to all Canadian industries and especially SME. APRO represents a force for technology transfer with its 2 200 employees (1 400 engineers, scientists and technicians), an annual budget of 125M$ and over 5 000 contracts per year.

APRO's contribution to the science and technology strategy can be presented as follows:
- as a catalyst between university and industry for better technology transfer;
- as a multiplicator for the rendering of services by the government laboratories;
- as a key institution for the diffusion, demonstration and adaptation of technology.

APRO's members are willing and available to participate in the coordination of the short-term implementation of a national policy for science and technology.

FACTORS OF IMPORTANCE FOR THE SCIENCE AND TECHNOLOGY POLICY

It is worth to know that R&D needs expressed by SME are much more tied up to the development and technical services field than to applied research. Requests formulated by SME are often a question of survival that merits particular and immediate attention for the implementation of a solution up to the follow-up in the production line. Ninety percent of R&D jobs performed for SME imply costs of less than 25 000$.

Although SME play an important role in the Canadian economy, a successful national policy will have to recognize the critical role of both large and small industry. Although SME have great job creation potential, much of the SME's role is as a supplier to large industry. Because of this interrelation, the national policy will have to address both SME and large industry.

Association des organismes provinciaux de recherches du Canada inc.

L'ASSOCIATION DES ORGANISMES PROVINCIAUX DE RECHERCHES DU CANADA ET L'ÉLABORATION D'UNE POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

L'ACQUISITION ET LE DÉVELOPPEMENT DES CONNAISSANCES NOUVELLES

Dans les universités

La mission unique et de considérable importance assumée par notre enseignement post-secondaire est, et doit demeurer l'éducation et la formation de personnes hautement qualifiées. Tous les programmes d'enseignement doivent mettre en relief le processus d'innovation sur les plans scientifique, technique et de gestion, afin de former une réserve abondante de chercheurs et de modifier l'attitude générale à l'égard de l'évolution technologique. Il ne sera jamais possible de sensibiliser le public à la nécessité d'une adaptation à cette évolution si nos futurs cadres syndicaux et industriels se sentent mal à l'aise devant cette éventualité.

La recherche universitaire constitue un outil important pour relever le défi posé au Canada par les sciences et la technologie; mais elle serait plus efficace si on lui désignait des objectifs. Et pour assurer une utilisation plus judicieuse des crédits disponibles, il faudrait allouer les subventions dans deux domaines préférentiels de recherches:

- la recherche libre, à long terme, réalisée par des centres d'excellence;
- les projets de recherches mettant en relief la communication de leurs résultats à l'industrie.

Bien que ce transfert de technologie nouvelle soit prévu par le mécanisme de collaboration université-industrie, bien peu est communiqué en fait, surtout à cause d'une trop lente prise en considération des besoins des petites et moyennes entreprises (PME) par les universités. Quand aux grandes sociétés industrielles, elles peuvent s'accommoder aisément d'un lent cheminement vers des avantages économiques. Les PME, par contre, ne peuvent attendre. Pour accélérer la communication de la technologie nouvelle à ces entreprises, nous faisons les recommandations ci-dessous. Elles visent à améliorer la compréhension réciproque entre fournisseurs et utilisateurs des résultats de la recherche:

- il faudrait que les enseignants universitaires accomplissant de la recherche à court ou à moyen terme soient déchargés de leurs responsabilités pédagogiques, et oeuvrent en étroite collaboration avec les organismes provinciaux de recherches (OPR) qui sont bien au courant des besoins des PME;
- il faudrait étendre les programmes de chercheurs invités que la plupart des OPR ont déjà mis sur pied à l'intention des étudiants et des enseignants en congé sabbatique;
- il faudrait renforcer la collaboration université-industrie grâce à l'intervention accélératrice des OPR, en utilisant judicieusement les relations bien établies de ces organismes tant avec les entreprises industrielles qu'avec les universités.

Dans les laboratoires de l'État

De nombreuses ressources matérielles et compétences techniques y sont déjà disponibles, mais parfois inutilisées. C'est la mise en oeuvre de lignes de conduite telles que celles recommandées par le "Centre d'étude de la technologie" et le "Rapport Nielsen" qui permettrait de les utiliser plus efficacement.

Ainsi des crédits seraient-ils attribués aux centres d'excellence qui obtiennent de bons résultats, en fonction des orientations prioritaires. Les laboratoires qui ont pour mission d'offrir des services externes aux entreprises industrielles devraient être exploités de façon commerciale, dans le cadre du réseau existant d'établissements locaux, régionaux et provinciaux.

Le réseau actuel d'OPR pourrait procurer à l'industrie un meilleur accès aux compétences techniques et aux moyens matériels dont disposent les laboratoires de recherches de l'État.

LA MISE EN OEUVRE DES CONNAISSANCES ET L'UTILISATION DES POSSIBILITÉS

Le transfert technologique

La diffusion auprès des PME, et la mise en oeuvre de la technologie la plus récente, qu'elle soit d'origine interne ou étrangère, sont déjà inscrites dans le mandat des OPR. La création, en Allemagne, de l'Institut Fraunhofer inc. a fourni un modèle utilisable dès à présent au Canada. Les membres de l'Association des organismes provinciaux de recherches (AOPR) entretiennent des liens étroits avec les universités voisines, avec les laboratoires de l'État dans la région, avec le Conseil national de recherches, avec les cabinets de consultance, avec les laboratoires locaux, régionaux, nationaux et internationaux, ainsi qu'avec les associations industrielles. Il faut que l'AOPR continue à frayer la voie à la diffusion de la technologie nouvelle auprès des PME, mais aussi qu'on étende son rôle et qu'on l'officialise, pour le plus grand avantage de l'économie canadienne.

Dans cette perspective, l'AOPR a besoin d'un soutien financier de l'État pour accomplir des recherches particulières sur les problèmes d'intérêt général qui déboucheront sur une diffusion de technologie nouvelle. Il faut noter que, pour accomplir cette dernière activité, on doit découvrir le savoir-faire, le comprendre et l'adapter avant de songer à le diffuser.

Les objectifs de l'effort scientifique et technique

Chaque pays industriel, à un certain moment, s'est efforcé d'axer tous ses efforts sur un domaine technologique lourd d'avenir. Il faut que d'urgence nos responsables cernent les domaines d'avenir intéressants, déterminent quels devraient être les rôles respectifs des divers secteurs de l'appareil scientifique et technique du pays dans chaque domaine désigné, et mettent sur pied un programme quinquennal ou décennal d'action pertinente.

L'ADAPTATION AU CHANGEMENT

La sensibilisation du public

Il ne sera pas possible de sensibiliser le public à la nécessité d'une adaptation au changement technologique tant que les travailleurs et les cadres de direction se sentiront mal à l'aise face à cette éventualité. On pourrait surmonter cette difficulté:

- en demandant au système d'enseignement de mettre l'accent indispensable sur la formation et le recyclage des intéressés;
- en soulignant, dans les programmes d'enseignement, la grande importance de la technologie;
- en mettant en place un mécanisme de récompense ou de pénalisation des entreprises et des syndicats ouvriers, afin d'encourager le recyclage des travailleurs dans des domaines nouveaux ; et
- en établissant de meilleures communications entre patronat et syndicats en matière de mise en oeuvre des technologies nouvelles.

Les OPR peuvent jouer un rôle important dans ce processus de sensibilisation, par le biais de leurs efforts de démonstration du nouveau savoir-faire technique et de formation des travailleurs pour les besoins des PME.

L'équilibre économique interrégional

Comme les pressions du marché engendrent à coup sûr des disparités entre régions, les autorités publiques pourraient assurer une meilleure répartition des intrants technologiques en favorisant l'établissement des communications convenables et efficaces au sein du secteur scientifique et technologique, et la décentralisation des actions technologiques nouvelles en fonction des priorités régionales et provinciales.

LA MISE EN OEUVRE DE LA POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

Les Administrations provinciales

Les Administrations provinciales devraient:
- déterminer les priorités provinciales ou régionales;
- fournir un soutien structuré, y compris des incitations fiscales et des subventions, afin de privilégier les priorités;
- négocier avec les autorités fédérales en matière de priorités nationales et régionales;
- financer la recherche et la diffusion de technologie nouvelle intéressant la province concernée; et
- adapter la politique d'enseignement à l'évolution technologique.

Par l'Administration fédérale

L'Administration fédérale devrait, entre autres:
- cerner les objectifs nationaux sur les plans scientifique et technologique, de concert avec les entreprises industrielles et les Administrations provinciales, en tenant compte des ressources et des compétences techniques disponibles;
- fournir une aide structurée à l'exportation, à l'élaboration des normes nationales, au recyclage des travailleurs et au développement du réseau d'information S-T, ainsi que des incitations fiscales et, quand ce serait nécessaire, attribuer des subventions;
- élaborer des lignes de conduite visant à réduire les disparités interrégionales futures; et
- financer la recherche et la diffusion de la technologie nouvelle intéressant l'ensemble du pays.

Le secteur privé

Tous les secteurs de cet agent économique devraient:
- préciser leurs besoins dans les domaines scientifiques et technologiques désignés;

- développer leurs communications avec les syndicats et encourager la formation et le recyclage des travailleurs; et
- participer plus activement à la mise en oeuvre exploratoire de la technologie nouvelle.

Par les syndicats ouvriers

Le monde du travail a, dans la mise en oeuvre de cette politique, un rôle à jouer aussi important que les autres intervenants. Acceptant l'accélération de l'évolution technologique, les syndicats devraient faciliter l'adaptation de la main-d'oeuvre en participant à son recyclage et à la modification du milieu de travail.

Par l'AOPR

L'Association des organismes provinciaux de recherches inc. (AOPR) groupe des établissements de recherches de huit provinces, dont l'objectif commun est de satisfaire les besoins de R-D, de services techniques et de données des entreprises industrielles du Canada. Recevant des subventions des autorités provinciales, l'AOPR offre les services d'installations et de spécialistes compétents à toutes ces industries, et plus particulièrement aux PME. L'AOPR accomplit un large effort de transfert technologique grâce à ses 2 200 travailleurs (dont 400 ingénieurs, scientifiques et techniciens) et à un budget annuel de 125 M$, et par le truchement de 5 000 contrats chaque année.

On peut décrire comme suit la contribution de l'AOPR à la mise en oeuvre de la stratégie scientifique et technologique:
- l'Association agit en accélérateur de la communication de la technologie nouvelle de l'université à l'entreprise industrielle;
- elle multiplie les avantages des services rendus par les laboratoires de l'État; et
- elle constitue un organe crucial pour la diffusion, la démonstration et l'adaptation de la technologie nouvelle.

Les membres de l'AOPR sont disposés à participer à la concertation de la mise en oeuvre à court terme de la Politique nationale des sciences et de la technologie.

DES CONSIDÉRATIONS IMPORTANTES POUR LA POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

Il faut remarquer que les besoins de R-D indiqués par les PME intéressent de beaucoup plus près le domaine des services techniques et de développement que celui de la recherche appliquée. Les demandes formulées par les PME ont souvent pour celles-ci une importance vitale, et méritent qu'on accorde sans retard une attention spéciale à la mise en oeuvre de la solution, jusqu'au suivi qui lui est donné à la chaîne de fabrication. Quatre-vingt-dix pour cent des actions de R-D réalisées pour les PME coûtent moins de 25 000 $.

Bien que les PME jouent un rôle important dans l'économie canadienne, la Politique nationale devra tenir compte du rôle aussi crucial des grandes entreprises. Les PME peuvent créer de nombreux emplois, mais ces entreprises sont souvent des fournisseurs de la grande industrie. Cette relation exige que la Politique nationale des sciences et de la technologie s'intéresse aussi bien aux PME qu'aux grandes entreprises.

THE ASSOCIATION OF PROVINCIAL RESEARCH ORGANIZATIONS OF CANADA INC. (APRO) AND THE NATIONAL R&D POLICY

May 1986

Foreword

In 1979, the Federal Government fixed a 1,5 per cent intensity rate for R&D expenditures in Canada to be achieved by the mid '80s. Highly publicized, that national objective was conveyed to industry by means of extended incentive measures that basically took two general forms: enlarged fiscal abatements and more generous assistance programs. Considering that 80 per cent of Canadian industrial R&D is usually performed by large firms, it was considered that this extended set of measures could be of great help in increasing R&D intensity in that segment of the industry. However, there was a fear that such a policy could not increase appreciably the R&D efforts from Small and Medium size Enterprises (SME) at the same rate unless they dispose of R&D facilities of their own, which most of them do not have and cannot easily obtain because of financial considerations and difficulties in hiring and retaining qualified people. The lack of political willingness has been such that very little came out of that 1979 objective.

In February 1985, the Federal and Provincial Ministers responsible for Science and Technology held a meeting in Calgary to establish some of the basis necessary for a National Policy on Science and Technology.

Another meeting was held in Toronto on April 24, 1985 to obtain the views of about twelve persons interested by various aspects of a National Policy on Science and Technology. At that time, it was realized that it is very difficult to put together a policy that will cover "all of the aspects" that people would like to see imbedded in a S&T policy. A consensus was reached on the idea that a broad policy covering all topics of interest would take a

long time to arrive at and would not be representative of what can be done as a nation considering the availability of our human and financial resources. Finally, it was suggested that the Canadian policy on S&T should be specific, covering only a few important issues, and be readily available.

It is hoped that the serious efforts made by the Federal Government, with the contribution of the Provincial Governments to define a Canadian S&T policy, will be more constructive and articulated that the "1979 vague intention".

The purpose of this short report is to suggest the use of the Association of the Provincial Research Organizations of Canada Inc. (APRO) because of its strategic position and broad experience in the fields of R&D, technology transfer and industrial innovation, as one of the best and most rapid way to make SME more active in those fields and to achieve the goals the Federal Government intends to reach with their National Policy on Science and Technology during the next decade or so.

The situation

It is estimated that there are about 750 manufacturing firms performing R&D on a current basis in Canada. Half of them alone account for more that 80 per cent of the money spent in such activities, and have at their disposal about the same proportion of all R&D professionals attached to industry throughout Canada and all the facilities that kind of activity implies. These firms register sales of 15M \$ and over and collectively employ some 500 000 workers.

In addition, our estimates show that at least 10 000 small and medium size manufacturing enterprises (of the 35 000 and over in operation in Canada) have to rely on R&D, technology transfer and innovation to face competition and survive. They employ about the same number of workers as the some 400 large firms performing R&D and produce more than one third of the value added by the whole manufacturing sector. Yet, most of them have neither the facilities nor the professional staff necessary to successfully undertake the research and the development they should. They essentially depend on existing R&D services provided by private research centres, by large firms and by public organizations to get their products, processes and equipments developed or improved.

Most of the time, however, private R&D organizations are not geared to adequately answer to requests coming from SME. It is worth knowing that R&D needs expressed by SME are much more tied up to development and technical services than to applied research. A request formulated by SME, very often a question of survival that merits a particular and immediate care, as much for the definition of the problem as for the follow-up of the solution through the production line, and that, in 90 per cent of cases, imply costs of less that 25 000 $. Only few organizations are disposed to engage in such activities where pre-project costs (re: visits to the firm, definition of the problem, preliminary studies, plan of work, etc.) amount to as much as 50 per cent of the cost of the job itself, and where the problems to solve are so dissimilar and unique that the infrastructure required supposes a polyvalency that only public organizations, such as PROs, could pretend to offer.

Even public organizations face big difficulties in dispensing their R&D services mainly because of the restrictions they impose to themselves regarding fees chargeable to SME. This way of doing business, on the one hand, seriously limits the financial resources at their disposal to cover the indirect costs implied by their operations and, on the other hand, to a large extent prevents them from getting the full impact they could and should have on SME in developing new activities for the benefit of these firms. Is it necessary to add that public industrial R&D organizations rely on not much more than 1 400 professionals to satisfy the R&D needs of some 10 000 SME?

In such conditions, and in spite of new assistance funds that could be provided by the Federal Government, there are indeed some doubts that the National Policy for S&T could obtain all the success it will deserve unless this prevailing situation is fully realized and coped with. On way of doing could be a better implication of the PROs.

The Association of Provincial Research Organizations of Canada Inc. (APRO)

The Association of the Provincial Research Organizations of Canada Inc. (APRO) groups institutions located in eight provinces*, namely Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, Ontario, Quebec and Saskatchewan, whose common goal is to satisfy Canadian industrial needs in R&D, technical services and information. Grant-aided by provincial administrations only, APRO offers R&D infrastructures and professional skills accessible to practically

* APRO has also very good ties with organizations located at P.E.I. and Newfoundland.

all industries in any region throughout Canada. Through time, their activities have made them an essential and an indispensable link in the Canadian industrial R&D chain, particularly for small and medium size firms. Indeed,

- the regional distribution of PROs allows them to comprehensively understand and carefully concentrate on local industrial and R&D needs and, therefore, to develop and/or adapt the most appropriate technologies;

- the support received from Provincial Governments imposes, on their activities, a social mission which takes the form of promoting, encouraging and rendering innovation accessible to all firms, an objective the Federal Government should by all means encourage in its National Policy for S&T;

- by the same token and to a larger extent, they largely contribute to the Federal efforts in reducing regional economic disparities, a problem that, in these days, makes technology practically the only or at least the most efficient way to alleviate it;

- finally, their exclusive R&D industrial orientation obliges them to be highly flexible in their organization and operations, an important faculty that is of great interest in foreseen efforts to greatly increase innovation in small and medium size firms.

Those broad considerations on the role and place of APRO and its members in the Canadian industrial and technology transfer chain is not a theoretical vision of what

they should be or do. They merely reflect the facts and actions of more than 300 years of collective experience that brought PROs to where they now stand.

Very few people realize that APRO represents quite a force for technology transfer: 8 R&D centres spread out across Canada, 2 200 employees (1 400 engineers, scientists and technicians), an annual budget of 125M $, 5 000 contracts/year, etc.

It is hoped that the new National S&T Policy will define an important role for APRO and that it will recognize the fact that APRO is a very efficient delivery mechanism for introducing technology to industries.

A suggested action to the Federal Government

This short note on the uncomfortable position of the Canadian R&D market and on the role the Provincial Research Organizations could and should play to improve it does not bring new fundamental ideas. PROs have made frequent representations to different Federal authorities during the last ten years and the extent of their activities and their credibility with Canadian firms are now well known. But, that their facilities, their professional staff and their typically polyvalent organization could serve as a master piece from among the few means at the disposal of the Government to make a success of its National R&D policy is a new approach that the Federal Government cannot rule out without serious consideration.

In carrying innovation right into SME plants, APRO is one efficient way to get this segment of the Canadian industrial structure in a position to face the rough competition of the '80s and '90s. No doubt that this

way of doing things would increase by a large factor the chances of the 2000's targets to be attained.

However, some conditions of the context where PROs now operate have to be improved first. The elimination, or at least an important elevation of the limit imposed to fees/day by DSS is one that would allow PROs to be more comfortable financially in dispensing their services to SME. The establishment of a new program, strictly for the use of PROs that would permit the development of new technologies (applied research) for the exclusive benefits of SME, is another improvement that is as necessary as the technical services already offered by PROs. A third improvement could be to support PROs in setting up and maintaining marketing teams entitled to promote innovation, to assist SME in drawing up new R&D projects and to guide them in their moves to get assistance from existing Federal programs. A forth one could be an agreement that would allow PROs a kind of matching grant, provided by the Federal Government, based on their activities with Canadian firms and aimed at improving existing services and developing new ones. Yet, the major priority, and the most urgent, remains the acknowledgement of PROs by the Federal Government, as designated R&D organizations for SME's R&D activities, at least in some specific areas. Such changes in PRO's relationship with Federal authorities would create a completely new context that could not fail to succeed in benefitting Canadian SME and, by doing so, help the Canadian economy as a whole.

APRO is expecting a lot from the National R&D policy for the benefit of Canadian economy and is willing to collaborate to its upmost.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Forum on a National Science and Technology Policy

Canadian Advanced Technology Association

June 8-10, 1986
Winnipeg, Manitoba

<u>MEMO</u>

TO: Federal and Provincial Ministers of Science & Technology

FROM: William G. Hutchison, Chairman
CATA National Advisory Council

DATE: 29 May, 1986

SUBJECT: <u>Attached Correspondence</u>

Attached you will find a letter from me on behalf of the National Advisory Council of the Canadian Advanced Technology Association. It is intended to assist your efforts to raise the political priority of Science and Technology.

The letter will be released to the Press at a press conference in Ottawa at 10:00 a.m. on Thursday, June 5th.

Good Luck in your Winnipeg Forum.

Sincerely,

William G. Hutchison
President

WGH:cs
Encl.

Office of the Minister of State — Cabinet du Ministre d'Etat
30 V 1986
ccm #1172
Science and Technology — Sciences et Technologie

Canadian
Advanced
Technology
Association

29 May, 1986

Minister of State
for Science & Technology
The Honourable Frank Oberle
235 Queen Street
Ottawa, Ontario
K1A 1A1

Dear Minister:

Ref: Forum on a National "Science and Technology Policy"

For well over a decade, Canada's advanced technology community has been calling for concerted national action to build technological strength as the basis for future wealth and job creation.

It is now apparent that Canada's position among the leading industrialized nations of the world is being seriously eroded. We are facing an industrial crisis. Nothing short of an immediate and sustained national commitment to technological excellence can reverse this trend. Science and technology has to be the cornerstone for a national strategy for economic renewal.

Members of the CATA National Advisory Council urge you to personally provide the political leadership required to bring this about.

Further delay in responding to this challenge will result in swift and certain decline in Canada's standard of living, rising unemployment and a steady weakening in Canada's ability to remain a politically sovereign and independent country.

Canada has many important technological achievements. However, our advanced technology base is small compared to other countries and we have failed to lay the groundwork to encourage rapid growth.

On a per capita basis, Canada is doing roughly half the R&D of major competitor countries. Canada employs fewer engineers and scientists on a per capita basis than most industrialized countries. Our mature industry sectors are slower than competitor countries to adapt to new technology. Canada's trade imbalance in advanced technology products has also been expanding at an alarming rate. The deficit has grown, by federal government estimates, at approximately 20 per cent per year since 1970 and now exceeds $12.5 billion. Canada is the only industrialized country in the world with a trade deficit in every advanced technology sector.

The private sector and the educational community in Canada are prepared to do their part to build national strength. However, the essential element required to catalyze national effort is political leadership. Consequently, the CATA National Advisory Council welcomes the meeting of federal and provincial Science Ministers on June 8-10 in Winnipeg as evidence of shared concern on these issues.

In a positive endeavour to achieve substantive progress at the Forum, the Advisory Council encourages you and your colleagues to act on the following points:

Research and Development

Given that technological momentum in Canada is actually declining (as measured by gross expenditures on research and development, as a percentage of GDP), that previous targets established for Canada (1.5 per cent of GDP as set out by the previous federal government; 2.5 per cent as set out in the election promises of the present government) will not be met, and that, in his book "Where I Stand", the Prime Minister has estimated that if the percentage of GDP allocated to R&D were to increase 1 per cent, "one million jobs and $20 billion in additional sales of manufactured products would result".

- will Ministers collectively agree to the establishment of a new national target for R&D expenditures as a guiding objective for the economy as a whole?

Free Trade

Given that technology is increasingly the key determinent of international competitiveness, and that free trade will be of greatest benefit to the most technologically sophisticated countries,

- will Ministers commit to the pursuit of free trade only in concert with the rapid introduction of a national science and technology policy and ensure proper and full science and technology input into the free trade discussion?

Investment Incentives

Given that governments expect the private sector to carry the major share of the burden for increasing national R&D expenditures, that Canada has one of the highest savings rates in the world, and that there is only a limited deployment of these savings to innovative enterprise (e.g. on a per capita basis, venture capital investment in start-up situations in the United States has consistently been up to six times as high as it is in Canada),

- will Ministers commit to the introduction of policies to encourage an increased flow of private investment into Canadian innovative enterprise and, in particular, to increase investment at the front end of the innovative chain?

Human Resources

Given that people are Canada's most valuable national asset in the global technology competition, that the "brain drain" of highly skilled individuals from Canada's leading science and technology institutions (largely to the U.S.) appears to have trebled in the last two years, that Canada trails most O.E.C.D. countries in the share of GDP allocated to University based research and development and that the movement towards a more technology oriented society will be severely constrained by a shortage of skilled manpower,

- will Ministers announce their collective intention to sharply increase the commitment of their governments to the funding of science and technology at all levels of the educational system?

Technology, Productivity and Competitiveness

Given that advanced technologies have become the key to cost reduction, productivity enhancement, improved product quality and international competitive strength in all industrial sectors, that the timeframes for adjustment to new technologies in many Third World countries is shortening, and that the rate of technology diffusion in Canada appears to be relatively slow,

- will Ministers commit to the adoption of productivity growth targets for established industrial sectors and to back the achievement of these objectives with directed technology development initiatives, programs and incentives to accelerate the pace of technology upgrading throughout Canadian industry?

Science and Technology in Government Decision-Making

Given that enhanced science and technology capability is a national imperative, that relevant policies must be oriented to longer term economic and social well-being, that political decision-making tends to focus on short term issues, and that Science and Technology Ministers are too often junior members of Cabinet and excluded from key decision making bodies,

- are Ministers and their governments prepared to commit to establishing science and technology advisory bodies reporting directly to the heads of government and to include Science Ministers in all relevant, strategic decision-making bodies including the Priority and Planning Committees of Cabinet?

Members of the CATA National Advisory Council appeal to the Prime Minister, to Provincial Premiers, and more specifically to the Science Ministers gathered in Winnipeg, to now halt the drift in Canada's technology performance and commit to a new, national development strategy with science and technology as its centrepiece. Time is running out.

You have the opportunity at the Winnipeg Forum to reach decisions that have the potential to move the country to a higher plateau of economic and social well-being. If your governments act, you will lay the foundation for long-term, competitive strength throughout all of Canadian industry. This new economic push will help meet the needs and expectations of today's youth and restore Canada to a position of leadership among the economically advanced countries of the world.

The CATA National Advisory Council believes that the private sector will respond to a call for an acceleration of their R&D as a vital step in revitalizing our industrial base. Such a response, however, demands: leadership at both federal and provincial levels; declared goals, targets and priorities; decisive, concerted action; and that governments provide the incentive to mobilize national effort. It demands your leadership.

In light of the urgency, we ask that, at the conclusion of the Winnipeg Forum, you respond specifically and publicly to these questions so that Canadians can measure your commitment to action.

Yours sincerely,

William G. Hutchison, (Chairman),
On behalf of the members of
The CATA National Advisory Council

WGH/cs
Encl.

CATA - NATIONAL ADVISORY COUNCIL

Canadian Advanced Technology Association

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6.	Mr. Des Cunningham (613) 692-3821	President Gandalf Technologies Inc. Ottawa, Ontario
7.	Mr. Alex Curran (306) 244-0976	President SED Systems Saskatoon, Saskatchewan
8.	Hon. William G. Davis, (P.C., C.C., Q.C.) (416) 865-0040	Former Premier, Province of Ontario Legal Counsel Tory, Tory, DesLauriers & Binnington Toronto, Ontario
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10. Mr. Pierre Ducros (514) 866-3301	President DMR Consulting Montreal, Quebec
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19.	Mr. William Newnham (416) 223-6769	Past President Seneca College Chairman Planning & Implementation Commission Ministry of Education Toronto, Ontario
20.	Dr. Wally A. Pieczonka (416) 632-2996	President Linear Technology Inc. Burlington, Ontario
21.	Mr. John Pollock (519) 744-7111	Chief Executive Officer Electrohome Kitchener, Ontario
22.	Dr. John Shepherd (416) 862-8108	Partner Nordicity Group Limited Toronto, Ontario
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25.	Mr. Roy Woodbridge (613) 236-6550	President Canadian Advanced Technology Association Ottawa, Ontario
26.	Dr. Douglas Wright (519) 885-1211	President University of Waterloo Waterloo, Ontario
27.	Dr. Hugh Wynne-Edwards (514) 848-8039	Vice President Research & Development Alcan International Ltd. Montreal, Quebec

DOCUMENT: 830-220/009

CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

<u>Conférence nationale sur la politique scientifique et technologique</u>

Association canadienne de technologie avancée

du 8 au 10 juin 1986
Winnipeg (Manitoba)

Association canadienne de technologie avancée (ACTA)
Suite 803
275, rue Slater
Ottawa (Ontario)
K1P 5H9
(613) 236-6550

Le 29 mai 1986

L'honorable Frank Oberle
Ministre d'État chargé
des Sciences et de la Technologie
235, rue Queen
Ottawa (Ontario)
K1A 1A1

Objet : Conférence nationale sur la politique scientifique et technologique

Monsieur le Ministre,

Voilà plus de dix ans que le secteur canadien de la technologie de pointe réclame une action concertée en vue de doter le pays des ressources nécessaires pour assurer la prospérité et créer des emplois.

Manifestement, le Canada risque présentement de perdre sa place parmi les chefs de file des pays industrialisés. Nous faisons face aujourd'hui à une véritable crise industrielle, que seul un engagement national à l'excellence technologique sera susceptible de résoudre. Les sciences et la technologie doivent être la pierre angulaire d'une stratégie nationale de redressement économique.

Les membres du Conseil consultatif national de l'ACTA vous exhortent à poser les jalons de cette réforme.

Si l'on ne relève pas ce défi dans les meilleurs délais, les Canadiens pourront s'attendre à un déclin rapide de leur niveau de vie, à une hausse du taux de chômage et à un affaiblissement marqué de la capacité du Canada à préserver sa souveraineté.

Le Canada a à son actif plusieurs réalisations technologiques importantes. Cependant, ses ressources en matière de technologie avancée sont très faibles à comparer à celles d'autres pays, et il n'a pas su prendre les mesures nécessaires pour en assurer une croissance rapide.

Proportionnellement à sa population, le Canada effectue moitié moins de travaux de R-D que ses principaux compétiteurs. De même, nous employons moins d'ingénieurs et de scientifiques par habitant que la majorité des pays industrialisés. Les secteurs industriels

arrivés à maturité sont plus lents à s'adapter aux nouvelles technologies que leurs concurrents étrangers. En outre, le déficit de la balance commerciale du Canada dans les produits de haute technologie s'accroît à un rythme alarmant. Selon les données du gouvernement fédéral, il a augmenté depuis 1970 de quelque 20 p. 100 par année, et dépasse maintenant 12,5 milliards de dollars. Le Canada est le seul pays industrialisé ayant un déséquilibre commercial dans tous les secteurs de la technologie de pointe.

Le secteur privé et le monde de l'enseignement sont prêts à pousser à la roue. Cependant, l'élément principal demeure la volonté politique. Conséquemment, le Conseil consultatif national de l'ACTA applaudit à la rencontre des ministres fédéral et provinciaux chargés des sciences et de la technologie, qui se tient du 8 au 10 juin à Winnipeg, y reconnaissant un intérêt partagé pour ces dossiers.

Soucieux d'assurer le succès de la conférence, le Conseil consultatif vous encourage, ainsi que vos collègues, à vous prononcer sur les points suivants :

Recherche-développement

Étant donné que l'innovation technologique au Canada est en perte de vitesse (comme en témoigne le pourcentage du PIB consacré à la R-D); que les objectifs établis (1,5 p. 100 du PIB pour le gouvernement précédent; 2,5 p. 100 selon le programme électoral du gouvernement actuel) ne seront pas atteints; et que, dans son livre intitulé Telle est ma position, le Premier ministre affirme que " si nous haussions de 1 p. 100 la part du PIB destiné à la recherche et au développement, nous pourrions créer au Canada un million d'emplois nouveaux et donner naissance à des ventes additionnelles de produits manufacturés pour un montant de 20 milliards de dollars ",

- les ministres s'entendront-ils pour que soit établi un nouvel objectif national en matière de R-D qui servirait également d'étalon pour l'économie en général ?

Libre-échange

Étant donné que la technologie joue un rôle de plus en plus essentiel quant à la compétitivité sur les marchés internationaux, et que le libre-échange bénéficiera surtout aux pays les plus avancés à cet égard,

- les ministres s'engageront-ils à n'appuyer le libre-échange que s'il est accompagné d'une politique nationale des sciences et de la technologie, et à faire en sorte que ces dossiers soient dûment considérés lors des négociations sur le libre-échange ?

Mesures d'incitation à l'investissement

Étant donné que les gouvernements comptent principalement sur le secteur privé pour accroître les dépenses nationales en R-D; que le Canada a un des taux d'épargne les plus élevés au monde; et que le pourcentage de cette épargne consacré à l'innovation est très faible (aux États-Unis, par exemple, le capital de risque investi dans de nouveaux produits ou de nouvelles entreprises est, par habitant, jusqu'à six fois plus élevé qu'au Canada),

- les ministres appuieront-ils l'adoption de mesures favorisant l'apport de capitaux privés aux entreprises novatrices du pays et, en particulier, l'accroissement des investissements en amont du processus d'innovation ?

Ressources humaines

Étant donné que les ressources humaines constituent le principal atout du Canada dans la course technologique; que " l'exode des cerveaux " (principalement vers les États-Unis), qui prive les principaux instituts scientifiques et technologiques du pays de personnel hautement qualifié, semble avoir triplé au cours des deux dernières années; que le Canada est presque au dernier rang des pays de l'OCDE en ce qui a trait au pourcentage du PIB affecté à la R-D universitaire; et que la pénurie de personnel qualifié nuira considérablement aux progrès technologiques de notre société,

- les ministres annonceront-ils leur intention d'accroître considérablement les crédits affectés par leur gouvernement respectif à la science et à la technologie, et ce à tous les niveaux du système d'enseignement ?

Technologie, productivité et compétitivité

Étant donné que les technologies d'avant-garde constituent dorénavant un facteur clé dans la réduction des coûts, l'accroissement de la productivité, l'amélioration de la qualité des produits et de la compétitivité, et ce dans tous les secteurs industriels; que, dans bien des pays du Tiers-Monde, les délais

d'adaptation aux nouvelles technologiques se font de plus en plus courts; et que le rythme de diffusion de la technologie au Canada semble relativement lent,

- les ministres s'engageront-ils à fixer des objectifs visant l'accroissement de la productivité dans des secteurs industriels établis, et à favoriser leur réalisation par le biais d'initiatives, de programmes et de stimulants propres à accélérer le rythme de la transformation technologique dans l'industrie canadienne ?

Sciences, technologie et processus décisionnel

Étant donné que l'accroissement de la capacité scientifique et technologique est devenu un impératif national; que les programmes pertinents doivent être axés sur le bien-être économique et social à long terme; que le processus décisionnel politique tend à accorder plus d'importance aux problèmes immédiats; et que les ministres chargés des sciences et de la technologie sont trop souvent des membres subalternes du Cabinet, ayant peu de pouvoir décisionnel,

- les ministres et les gouvernements qu'ils représentent sont-ils disposés à créer des organes consultatifs en matière de science et de technologie relevant directement de leurs premiers ministres, et à faire en sorte que les ministres chargés des sciences et de la technologie fassent partie de tous les organismes décisionnels stratégiques, notamment le Comité des priorités et le Comité de planification du Cabinet ?

Les membres du Conseil consultatif national de l'ACTA exhortent le Premier ministre du Canada, les premiers ministres des provinces et plus particulièrement les ministres chargés des sciences et de la technologie, réunis à Winnipeg, à mettre fin au déclin de la performance technologique du Canada et à s'engager à adopter une nouvelle stratégie de développement national axée sur les sciences et la technologie. Nous sommes engagés dans une course contre la montre.

La conférence de Winnipeg vous offre la possibilité de prendre des décisions susceptibles d'améliorer sensiblement le bien-être économique et social du pays. Si les gouvernements que vous représentez prennent les mesures qui s'imposent, vous aurez jeté les bases de la capacité concurrentielle à long terme de l'ensemble de l'industrie canadienne. Cette nouvelle impulsion économique contribuera à satisfaire les besoins et les attentes des jeunes, et permettra au Canada de reprendre sa place parmi les chefs de file des pays industrialisés.

Le Conseil consultatif national de l'ACTA est d'avis que le secteur privé ne demande pas mieux que d'accélérer ses travaux de R-D, condition essentielle à la revitalisation de notre base industrielle. Mais pour ce faire, il doit bénéficier d'un engagement aussi bien à l'échelle fédérale que provinciale; d'objectifs et de priorités bien définis; d'une action concertée; et de stimulants propres à mobiliser un effort national. Il n'en tient qu'à vous que tout cela se réalise.

Face à l'urgence de la situation, nous vous demandons de répondre publiquement à ces questions à l'issue de la conférence, afin de permettre aux Canadiens de juger de votre bonne volonté.

Veuillez agréer, monsieur le Ministre, l'expression de mes sentiments les meilleurs.

Le président,

William G. Hutchison
pour les membres du
Conseil consultatif
national de l'ACTA

DOCUMENT: 830-220/010

CONFÉRENCE NATIONALE SUR LA POLITIQUE
SCIENTIFIQUE ET TECHNOLOGIQUE

<u>L'élaboration d'une politique nationale des sciences et de la technologie</u>

Association canadienne des physiciens

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

Présentation de l'Association canadienne des phyciciens concernant l'élaboration d'une politique nationale des sciences et de la technologie*

J.S.C. McKee, vice-président

(La numérotation des paragraphes correspond à celle des questions qui nous ont été soumises.)

1. Pour ce qui est du développement et de l'acquisition de nouvelles connaissances, il nous faut faire quelques observations :

a) Il y a bien des raisons pour lesquelles le Canada peut ne pas retirer le maximum de la recherche faite par les universités. Dans certains cas, le groupe de chercheurs n'est pas assez nombreux ni vraiment concurrentiel. Dans d'autres, le domaine de recherche n'est pas assez bien défini comme se trouvant aux frontières de la connaissance. Toutefois, la raison majeure est que ni les gouvernements provinciaux ni le gouvernement fédéral ne savent tirer profit du vaste bassin de compétences techniques disponibles au Canada, lorsqu'ils ont besoin des conseils d'experts, d'un nouveau concept ou d'une innovation technique. Il faut sans délai établir des répertoires provinciaux et nationaux de chercheurs de renom, en y indiquant leur domaine de compétence; il faut également que le gouvernement facilite l'accès aux connaissances techniques et scientifiques existant au Canada et qu'il profite lui-même des connaissances accumulées.

b) Le Canada ne peut aspirer à un avenir technologique assuré, sans l'application de fonds supplémentaires à la recherche scientifique pure dans les universités. L'histoire ne fait état que de deux occasions où l'avènement d'une technique a précédé le développement de la science fondamentale sur laquelle elle s'appuyait, à savoir : la découverte du moteur à vapeur par M. Watt, cent ans avant l'énoncé de la deuxième loi de la thermodynamique par Clausius et la formulation de la théorie de l'information par Shannon. Dans tous les autres cas connus, la science a précédé la technologie, habituellement d'un minimum de vingt-cinq ans.

Comme les placements consentis à la recherche scientifique pure constituent toujours ni plus ni moins un acte de foi et que les formules magiques pour assurer le financement de ce secteur sont difficiles à trouver, je joins en annexe un bref article sur le sujet, paru il y a

quelques années dans Canadian Research, et recommande qu'on en adopte le principe directeur (cf. "Death of a Sacred Cow", en annexe).

Maintenir et augmenter les placements en sciences pures nous permettra d'assurer à nos plus grands esprits la possibilité de fonctionner au Canada et de constituer un corps de chercheurs actifs qui non seulement comprennent et apprécient les nouvelles techniques, à mesure qu'elles font jour, mais assurent également une présence canadienne dans les nouveaux champs d'activité qui se dessinent.

Même lorsque les fonds sont limités, il faudrait continuer d'appuyer les groupes dont les recherches donnent des résultats. Même par les temps les plus durs, il faudrait continuer d'investir dans la réussite.

c) Pour ce qui est de la collaboration entre les universités et l'industrie, il peut s'avérer utile d'instituer un nouveau genre de journées d'accueil dans les universités. Ces journées ne s'adresseraient pas aux éventuels diplômés, comme le font celles qu'on tient à l'heure actuelle, mais plutôt au gouvernement et à l'industrie, qui seraient invités à visiter les laboratoires universitaires et à prendre connaissance des projets de recherche qu'on y mène. Des communications de la sorte se sont avérées d'un bienfait sans pareil pour l'avancement de la technologie dans plusieurs pays européens ces dernières années, et le modèle semble offrir un moyen convenable d'établir un rapport direct entre les chercheurs universitaires et le secteur privé, tant à l'échelon local que national, au Canada.

d) L'Association canadienne des physiciens peut aider à faire fructifier le capital intellectuel du Canada, en organisant des conférences avec ses sociétés membres et des débats axés sur les rapports particuliers entre la physique et l'industrie et en établissant l'ordre dans lequel les nouveaux projets scientifiques de ses divisions devraient être entrepris. Elle devrait jouer un rôle plus actif qu'auparavant dans ces domaines.

2. a) Les laboratoires gouvernementaux ont un important rôle à jouer dans certains domaines de la recherche, du développement et des services touchant l'industrie et dans l'établissement d'une fonction nationale d'analyse et de surveillance. Il ne faudrait ni trop les centraliser ni les isoler géographiquement des autres organismes de recherche oeuvrant dans des domaines connexes. Ces laboratoires sont peut-être les meilleurs endroits où effectuer, en toute sécurité, les recherches industrielles dont l'exécution nécessite des installations particulières.

8. L'Association canadienne des physiciens se doit de souligner les problèmes assortis à la promotion du transfert des améliorations technologiques. Les entreprises de collaboration les mieux réussies entre l'université et l'industrie sont celles où un chercheur universitaire demande un produit unique à l'industrie et en paie pour ainsi dire la mise au point à même la subvention de recherches que lui consent le gouvernement fédéral ou une autre source. L'industrie se crée alors un marché en fonction de la nouvelle technique ou du nouvel instrument qu'elle a mis au point. Il est très rare ce soit l'industrie qui cherche à tirer profit des compétences et des appareils des universités . C'est pourquoi la suggestion faite au point 1. c) et le répertoire proposé en 1. a) nous semblent appropriés.

. . .

9. L'enseignement à tous les niveaux est un élément essentiel pour que les Canadiens puissent fonctionner avec efficacité dans un milieu technologique en évolution continuelle. Tous les moyens de communication -- revues scientifiques de vulgarisation bien informées, émissions de radio et de télévision et centres des sciences nouveau genre, permettant aux visiteurs d'acquérir une expérience pratique de la science -- sont importants et, de fait, ont un rôle essentiel à jouer. L'enseignement de la science à l'école et à l'université n'a jamais été aussi nécessaire qu'aujourd'hui et devrait constituer un élément fondamental de tout programme d'études moderne.

12. Le rôle des gouvernements fédéral et provinciaux devrait consister à assurer les conditions propices à l'avancement de la recherche dans les universités. La majeure partie de la recherche et un certain nombre des travaux de développement seront et devraient être exécutés par les universités, dont la valeur pour le secteur privé continuera de tenir surtout à la formation d'une main-d'oeuvre spécialisée pour l'industrie.

. . .

13. L'Association canadienne des physiciens se réjouit de l'établissement d'organes comme l'Association of Science and Technology - Related Associations/Association des groupements scientifiques et technologiques (ASTRA) nouvellement constitue au Manitoba. Ces organes peuvent intégrer les organisations professionnelles et industrielles en un modèle constructif et si on s'en sert pour essayer de nouvelles idées, ils peuvent être un outil

précieux tant pour le gouvernement que pour l'industrie. À ce titre, ils méritent donc d'être appuyés. L'Association canadienne des physiciens se réjouit de compter parmi les membres fondateurs de l'ASTPA.

14. Les associations, telle l'Association canadienne des physiciens, devraient être encouragées à sensibiliser davantage leurs membres aux effets de la science (notamment ceux de la physique) et des techniques connexes sur la société en général. Elles peuvent en outre les sensibiliser davantage aux utilisations possibles de la recherche pure et à l'importance de ses liens avec les sciences appliquées et la technologie. Elle peut aussi les encourager à acquérir des brevets canadiens pour les techniques et instruments qu'ils lancent ou mettent au point.

Le vice-président de
l'Association canadienne des physiciens,

J.S.C. McKee

*Pour le moment, le présent document exprime seulement les vues de l'auteur. Il sera présenté à l'approbation rétroactive du Conseil de l'Association, à sa prochaine assemblée, en juin 1986.

Death of a sacred cow

by J. S. C. McKee
Department of Physics, University of Manitoba

THE SOMEWHAT BRIEF love affair between society in general, and science in particular, has run its course. In a now familiar financial environment of increasing stringency and diminishing resources, the need to fund basic scientific research is frequently being called in question, and doubts as to the essential value of such research to our future technology are continually being raised.

Basic research in science is not, however, the easiest of endeavours to defend. Pure research, although directed towards broadening in some sense the foundations of scientific knowledge cannot be justified intrinsically by any arguments concerning utility. This is true whether the research be in microbiology, chemistry, or nuclear physics. In the introduction to a recent report of the Joint AECB/NRC Advisory Committeee on Nuclear Physics Priorities (1976) the relationship between nuclear physics in particular, and technology is discussed and an argument made that nuclear physics has both contributed to, and benefited from technology. "The two are closely entwined and in a state of continuous interaction," says the report. This is true: and in addition, in the light of past experience, it seems clear that technological 'spin-off' has often accompanied or followed a major advance in pure science. But there are contrary illustrations. The invention of the steam engine, for example, preceded the development of the science of thermodynamics.

It was not until after 1841 that the concept of conservation of energy was invoked and the theory of engines and heat flow formulated in a satisfactory manner. The original designs for machines which could convert the heat contained in steam into work, were made some fifty years earlier by "dilettantes such as Watt who were tinkerers at heart and primarily interested in the technological efficiency and economic utility of the new devices" to quote Schroeder. It seems, therefore, that in considering the future of basic research we are concerned with an aspect of scientific endeavour which does not have utility as its immediate justification. Not that this fact should belittle its relevance in any way. Chadwick's discovery of the neutron in 1932 was not related in any conceptual or direct way to the development of energy sources in the 1980s. Indeed, had the same funding agencies existed fifty years ago as exist today it might have been difficult, in the absence of an adequate theory for the process, to justify the financing of a 'search for neutral particles in the bombardment of Beryllium by alpha-particles'.

Such esoteric research is indeed not often directly of benefit to society at large, although it clearly contributes to the broad base of scientific knowledge, and indirectly to the development of new ideas and technologies.

The most attractive, and in many ways the most useful, definition of basic science is as a consensus activity in which the participant contributes directly to the store of public knowledge. This view was first put forward by Ziman in 1968, and is worthy of further consideration at the present time. In his view, scientific knowledge is something to which any reasonable person who makes the effort at understanding can subscribe, and this definition gives science a uniqueness not found in other disciplines. According to Ziman, the rules of scientific communication and controversy are dominated by a single principle, the establishment and extension of a free intellectual consensus. And, presumably, as long as the love affair of society with science was in full bloom, the health of the scientific community over which the consensus is established was synonymous with the health of society as a whole. There existed an implicit unity of interest and responsibility between the two. Recently, however, it has become increasingly apparent that this unity of purpose is no longer to be found. The scientific community is to a significant extent being rejected by a suspicious and sceptical society, which sees the scientist as the villain rather than the hero of the contemporary scene.

The pendulum of popularity has, for reasons perhaps more political than rational, swung so far that the need for scientific research is no longer apparent to the community at large, and financing of fundamental scientific investigation regarded as an unnecessary indulgence by society. Nonetheless, experience and history suggest that a developing technology requires sound scientific principle upon which to build, and that in the absence of new discoveries and continuing of detailed investigations, not only pure science, but also technology, will stagnate. So, the funding of both basic and applied science continues to be important to a technologically dependent society, and the Ziman criterion can be used to distinguish, in a sensible manner, between the two.

If we accept science as an activity directed toward public knowledge and a consensus, then the financing of pure research cannot in any way be justified by arguments about utility despite the fact that such research has often in the past provided the springboard for a new technology. Conversely, if research is intentionally directed towards usefulness,

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SACRED COW . . .

continued from page 21

then it is no longer basic science. no matter how 'scientific' the work appears to be to the observer. The criterion then enables us to distinguish clearly between the financing of production-oriented research and development programs and the much lower level of funding for basic non-utilitarian pure research projects. The economic benefits of particular R and D programs can of course in most cases be readily assessed, whereas the economic benefits of basic research should in a real sense be accepted as an article of faith, a situation which governments and funding agencies both instinctively dislike. There could, however, be a realistic solution to this difficulty. Weinberg, 1967, has suggested that basic science may best be considered as an overhead charge on applied science, and by implication, on R and D in general. This formula is an attractive if difficult one to implement because the funding of the two is usually undertaken by different agencies using quite separate and unrelated criteria for evaluation. The splitting of the science pie into applied and pure science is not usually carried out in a transparently logical way. Pure research is largely seen as an investment in the future, a present outlay in the hope of later rewards, and accordingly difficult to evaluate in terms of current worth.

But, while all original work is in some sense or other valuable. the cost of each separate research program must require analysis and the degree of duplication between laboratories be taken into account. 'Adequate' funding is not 'unlimited' funding. The current situation in Canada is of 'inadequate' funding. Clark, 1976, has pointed out that whereas, in Canada, there has recently been no shortage of funds for scientific activity in federal departments, those for basic research in universities have fallen in real terms by as much as 35% since 1970, while the gross domestic product has increased by 67% over the same period. The debate in the Parliament of Canada of June 9th, 1975, as reported by Wilson, has recently emphasized the need for a science and technology policy and for the identification of national objectives for science. The quantification of the Weinberg criterion might be a useful stepping stone toward such a policy. Of course it can be said, as Clark has indicated, that limited resources must go to those researchers whose work is most likely to succeed, that duplication be avoided, and that entry into expensive new fields of scientific endeavour be avoided at this time. The word 'limited', however, requires to be rationalized. Pure research, when considered as an overhead charge on applied science, must be able to attract funding at a level consistent with maintaining the kind of forward looking programs and imaginative projects that were a feature of pure science in Canada until recent years.

If it becomes possible to define and maintain a degree of basic research funding that is related to both R and D and to federal spending as a whole, this will ensure a continuing investment in the future of science and technology in Canada and that degree of scientific independence essential to the health, confidence and inventiveness of the present generation of Canadian scientists.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Development of a National Science and Technology Policy

Canadian Association of Physicists

June 8-10, 1986
Winnipeg, Manitoba

CANADIAN ASSOCIATION OF PHYSICISTS

ASSOCIATION CANADIENNE DES PHYSICIENS

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May 21, 1986

The Honourable Frank Oberle
Minister of State for Science and Technology
Ottawa, Ontario
K1A 1A1

Dear Minister:

In response to your request of April 30, 1986, I am happy to forward my views in a paper which can hopefully contribute to the development of a national policy for Science and Technology. Any enquiries concerning this paper should be sent to me directly at the above address. I look forward to the forum on June 8-10, 1986.

Yours sincerely,

J.S.C. McKee,
Vice-President,
Canadian Association of Physicists.

JSCM/jk

Encls.

Paper presented on behalf of the Canadian Association of Physicists in relation to the development of a National Science and Technology Policy+

J.S.C. McKee, Vice-President, C.A.P.

(Numbered paragraphs correspond to those in the question paper provided)

1. In relation to the development and acquisition of new knowledge, several points should be made:-

a.) There are many reasons as to why Canada may not be getting maximum benefit from University research. On occasion a research group is below critical size and is not truly competitive. In others the research area is not clearly enough defined as a frontier for new knowledge. Most important however is the fact that both Provincial and Federal Governments fail to take advantage of the large pool of technical expertise available in Canada when expert advice, design or technical innovation is required. National and Provincial Directories of successful researchers and their areas of expertise are urgently required, as is the need for Government to foster and access the scientific knowledge and techniques available in this country.

b.) Without additional funds for basic research at Universities, there can be no sound technological future for Canada. On only two recorded occasions has history shown a new technology to have preceded the fundamental science on which it is based -- these being Watt's discovery of the steam engine 100 years prior to Clausius statement of the second law of thermodynamics, and Shannon's development of Information Theory. In all other recorded instances the science

has preceded the technology, usually by a minimum of twenty-five years development time.

As investment in basic research is to some extent always an act of faith, and recipes for funding it difficult to derive. I append a short discussion of this topic which appeared in Canadian Research several years ago, and commend its philosophy (see `Death of a Sacred Cow' - attached).

Continuing and developing investment in fundamental science ensures that our most able minds will have an operational base in this country, and form a body of active research scientists who not only understand and appreciate new technologies as they develop but also ensure a Canadian presence in new and developing fields as they emerge.

When funds are limited, successful research groups should still be supported. In the leanest times one should still invest in success.

c.) Where University-Industry Cooperation is concerned, a new kind of University Open House can prove valuable. In this, the University does not open its doors to potential undergraduates in the traditional manner, but rather opens its research laboratories to Government and Industry, by means of ticket-only invitation. Such public communication has proved invaluable to technological development in several European countries in recent years, and this model seems appropriate for relating University researchers in Canada directly to the Private Sector, both locally and Nationally.

d.) The CAP can help to develop the intellectual capital in Canada through organizing Conferences with its Corporate Members, holding forums focussed on particular physics/industry interfaces, and through the priorization of new scientific projects within particular Divisions of its membership. It should

play a more active role in these areas than previously was the case.

2. a.) Government laboratories have an important role to play in certain areas of industry-related research, development and service, and in developing a National monitoring and analysis function. They should not be overly centralized, or geographically isolated from other researchers in related fields. Secure industrial research may best be carried out at Government laboratories.

6. The CAP draws attention to problems in promoting enhanced technology transfer. The most successful partnerships between University and Industry arise when a University researcher requires a unique product from Industry and basically pays the development cost through his Federal or other research grant. Industry then builds a market on the basis of the new technique or instrument it has now developed. Rarely does Industry come to the University to take advantage of its expertise and instrumentation. That is why the suggestion made in 1 c.) is appropriate, as is the Directory proposed in 1 a.).

. . .

9. In order that ordinary Canadians can function effectively in a changing technological environment, education at all levels is an essential component. Informed scientific journals written at a lay level; television and radio programming, and new-style science centres where hands-on interactive science can live and prosper, all have an important and indeed essential role to play. Science teaching in the schools, and at University has never been more necessary than today and should form an essential component of any modern day curriculum.

12. The role of Federal and Provincial Governments should be to provide an environment within which research at Universities can prosper. Much of the

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THE SOMEWHAT BRIEF love affair between society in general, and science in particular, has run its course. In a now familiar financial environment of increasing stringency and diminishing resources, the need to fund basic scientific research is frequently being called in question, and doubts as to the essential value of such research to our future technology are continually being raised.

Basic research in science is not, however, the easiest of endeavours to defend. Pure research, although directed towards broadening in some sense the foundations of scientific knowledge cannot be justified intrinsically by any arguments concerning utility. This is true whether the research be in microbiology, chemistry, or nuclear physics. In the introduction to a recent report of the Joint AECB/NRC Advisory Committeee on Nuclear Physics Priorities (1976) the relationship between nuclear physics in particular, and technology is discussed and an argument made that nuclear physics has both contributed to, and benefited from technology. "The two are closely entwined and in a state of continuous interaction," says the report. This is true: and in addition, in the light of past experience, it seems clear that technological 'spin-off' has often accompanied or followed a major advance in pure science. But there are contrary illustrations. The invention of the steam engine, for example, preceded the development of the science of thermodynamics.

It was not until after 1841 that the concept of conservation of energy was invoked and the theory of engines and heat flow formulated in a satisfactory manner. The original designs for machines which could convert the heat contained in steam into work, were made some fifty years earlier by "dilettantes such as Watt who were tinkerers at heart and primarily interested in the technological efficiency and economic utility of the new devices" to quote Schroeder. It seems, therefore, that in considering the future of basic research we are concerned with an aspect of scientific endeavour which does not have utility as its immediate justification. Not that this fact should belittle its relevance in any way. Chadwick's discovery of the neutron in 1932 was not related in any conceptual or direct way to the development of energy sources in the 1980s. Indeed, had the same funding agencies existed fifty years ago as exist today it might have been difficult, in the absence of an adequate theory for the process, to justify the financing of a 'search for neutral particles in the bombardment of Beryllium by alpha-particles'.

Such esoteric research is indeed not often directly of benefit to society at large, although it clearly contributes to the broad base of scientific knowledge, and indirectly to the development of new ideas and technologies.

The most attractive, and in many ways the most useful, definition of basic science is as a consensus activity in which the participant contributes directly to the store of public knowledge. This view was first put forward by Ziman in 1968, and is worthy of further consideration at the present time. In his view, scientific knowledge is something to which any reasonable person who makes the effort at understanding can subscribe, and this definition gives science a uniqueness not found in other disciplines. According to Ziman, the rules of scientific communication and controversy are dominated by a single principle, the establishment and extension of a free intellectual consensus. And, presumably, as long as the love affair of society with science was in full bloom, the health of the scientific community over which the consensus is established was synonymous with the health of society as a whole. There existed an implicit unity of interest and responsibility between the two. Recently, however, it has become increasingly apparent that this unity of purpose is no longer to be found. The scientific community is to a significant extent being rejected by a suspicious and sceptical society, which sees the scientist as the villain rather than the hero of the contemporary scene.

The pendulum of popularity has, for reasons perhaps more political than rational, swung so far that the need for scientific research is no longer apparent to the community at large, and financing of fundamental scientific investigation regarded as an unnecessary indulgence by society. Nonetheless, experience and history suggest that a developing technology requires sound scientific principle upon which to build, and that in the absence of new discoveries and continuing of detailed investigations, not only pure science, but also technology, will stagnate. So, the funding of both basic and applied science continues to be important to a technologically dependent society, and the Ziman criterion can be used to distinguish, in a sensible manner, between the two.

If we accept science as an activity directed toward public knowledge and a consensus, then the financing of pure research cannot in any way be justified by arguments about utility despite the fact that such research has often in the past provided the springboard for a new technology. Conversely, if research is intentionally directed towards usefulness.

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research and some of the development will and should be carried out at Universities, whose main value to the Private Sector will continue to lie in the production of skilled manpower for industry.

. . .

13. The CAP welcomes the introduction of vehicles such as ASTRA, the Association of Science and Technology-Related Associations (Manitoba), which can relate professional and industry related organizations together in a forward-looking model. Such a body when seen as sounding board for new ideas can be invaluable to both Government and Industry, and deserves continuing support. CAP is happy to be a founding member of ASTRA.

14. Associations such as the CAP should be encouraged to foster increased awareness of the impact of science (in this case physics) and related technologies upon society in general. It can make its members more aware of the potential applications of pure research and of the importance of the interface with applied science and technology. It can also encourage its members in the acquisition of Canadian patents for appropriate techniques and instruments initiated or developed by its members.

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Vice-President,
Canadian Association of Physicists.

+This paper at present reflects only the views of the author. It will however be presented to the upcoming meeting of the CAP Council in June 1986 with request for retroactive approval.

SACRED COW . . .

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then it is no longer basic science, no matter how 'scientific' the work appears to be to the observer. The criterion then enables us to distinguish clearly between the financing of production-oriented research and development programs and the much lower level of funding for basic non-utilitarian pure research projects. The economic benefits of particular R and D programs can of course in most cases be readily assessed, whereas the economic benefits of basic research should in a real sense be accepted as an article of faith, a situation which governments and funding agencies both instinctively dislike. There could, however, be a realistic solution to this difficulty. Weinberg, 1967, has suggested that basic science may best be considered as an overhead charge on applied science, and by implication on R and D in general. This formula is an attractive if difficult one to implement because the funding of the two is usually undertaken by different agencies using quite separate and unrelated criteria for evaluation. The splitting of the science pie into applied and pure science is not usually carried out in a transparently logical way. Pure research is largely seen as an investment in the future, a present outlay in the hope of later rewards, and accordingly difficult to evaluate in terms of current worth.

But, while all original work is in some sense or other valuable, the cost of each separate research program must require analysis and the degree of duplication between laboratories be taken into account. 'Adequate' funding is not 'unlimited' funding. The current situation in Canada is of 'inadequate' funding. Clark, 1976, has pointed out that whereas, in Canada, there has recently been no shortage of funds for scientific activity in federal departments, those for basic research in universities have fallen in real terms by as much as 35% since 1970, while the gross domestic product has increased by 67% over the same period. The debate in the Parliament of Canada of June 9th, 1975, as reported by Wilson, has recently emphasized the need for a science and technology policy and for the identification of national objectives for science. The quantification of the Weinberg criterion might be a useful stepping stone toward such a policy. Of course it can be said, as Clark has indicated, that limited resources must go to those researchers whose work is most likely to succeed, that duplication be avoided, and that entry into expensive new fields of scientific endeavour be avoided at this time. The word 'limited', however, requires to be rationalized. Pure research, when considered as an overhead charge on applied science, must be able to attract funding at a level consistent with maintaining the kind of forward looking programs and imaginative projects that were a feature of pure science in Canada until recent years.

If it becomes possible to define and maintain a degree of basic research funding that is related to both R and D and to federal spending as a whole, this will ensure a continuing investment in the future of science and technology in Canada and that degree of scientific independence essential to the health, confidence and inventiveness of the present generation of Canadian scientists.

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The Canadian Association of University Research Administrators
(CAURA)

Statement to the Canadian Forum on a National Science and Technology Policy, Winnipeg, June 8-10, 1986.

The membership of CAURA consists of three categories of research administrators: 1) directors and administrators of offices of research grants, contracts and services who are engaged in administering external, as well as internal, research funds; 2) technology transfer officers, who are concerned with research relations with the private sector, patenting and copyrighting intellectual property and with commercializing university discoveries and research; senior university research executives (Vice-Presidents [Vice-Princiapls, Vice-Rectors], Associate or Assistant Vice-Presidents, Deans and Directors) specifically concerned with university research and with research policy in all their dimensions. While the official university response to federal initiatives must come from the Association of Universities and Colleges of Canada (AUCC), which is the collectivity of university presidents, CAURA is uniquely qualified to present the viewpoint of those directly involved with the management and funding of university-based research.

At the recent CAURA meetings at the University of British Columbia (May 11-13, 1986), senior research executives of the major Canadian research universities participated in a vigorous and far reaching discussion of the proposal contained in Mr. Wilson's February budget with respect to a program for federal government matching of private sector contributions to the research councils in support of university research. The purpose of the CAURA discussion was to reach consensus as to the conditions that would induce the universities to participate actively in such a program. The present position paper will outline potential problems that might discourage many universities

from participating actively and outlines alternative models that would doubtless prove to be acceptable to them.

This paper will not present a detailed proposal with definitions of private sector, incremental funding, research and so on. We would be happy to help provide definitions for these contentious terms, if called upon to do so. Nor shall we insist on what many industry and university people have pointed out, namely that were the Government deliberately to have opted for a program that would shift the responsibility for funding the basic scientific, engineering and scholarly research to the shoulders of others it might well have come up with a scheme such as this one. Nor shall we present a detailed alternative proposal in which we spell out incentives to be offered to the private sector or the universities; again, we would be happy to do so if our advice is sought.

On the other hand, we shall not forbear to point out that even were industry to make the maximum contributions envisaged by this proposal and the Government to make the maximum yearly matching grants to the Councils over the next five years, the amounts available to the Councils will scarcely be greater than their present budgets in 1986 dollars and far from those required to fund the five year plans of the three Councils; given the expected rise in cost of equipment and supplies, the budgets of the three research councils at the end of the five year period (1990-91) will be significantly lower in real dollars than in 1986-7 even with the maximum private sector contributions and matching dollars.

Before considering the central issue, that is the conditions under which the universities of Canada would be likely to cooperate in the Government's matching grants program, one other point must be made. When the present government was in opposition, it quite correctly insisted on the need to increase greatly the Canadian commitment to research and development in order to assure the economic future of the country and a sound Canadian presence in the advanced technology sector. Mr. Mulroney put it well: "The starting line for me is the technological dimension. Either we go into the game and become important players in this major league or we become a nation that will, during its entire lifetime, play in the Junior B circuit. To play with the majors, we must make a firm commitment to double the public and private funds allocated to research and development before 1985. Research and development, and the resulting innovations, are the lifeblood of a successfull economy and country." (Chapter IV, Research and Development, p.39, "Where I stand").

CAURA recognizes the need for financial restraint in view of the crushing accumulated federal deficit. Nevertheless, it is evident that research is not a luxury to be indulged in only when times are good; on the contrary, a country that neglects research and development in tough economic times has been likened to a primitive society that consumes its seed corn in times of famine. Our view is that the Government ought to find the means to support the five year plans of the three federal granting councils. Adequate support of the research and manpower programs of the Councils is an essential investment in and for the future of our country.

Turning to the proposal to match private sector contributions to university research sponsored by the Councils, CAURA reached a clear consensus on the following points:

1. The matching program might present grave dangers both to the universities and to the three Councils, depending on the rules that the Government imposes and about which we have no information at the time of writing. Some of these putative dangers are:

a) a shift in focus of the Councils away from emphasis on support of basic scientific, engineering and scholarly research to narrowly applied research and development generating proprietary information helpful to a particular industry or business in exchange for a contribution to the Council in question. The Universities will oppose any measures that might lead to such a transformation of the Councils since support of basic research must remain their function; applied R&D depends squarely on adequate funding of fundamental research, a lesson ignored by a nation at its peril.

b) A destructive competition among Councils for gifts from industry, with a probable inability of one or other councils to secure a reasonable share of industrial and other private sector funding.

c) Interference with traditional university fund-raising activities in the private sector and with the usual university-based contract research for industry and business. In particular, the universities

will resist introduction of contract-type research masquerading as grants to be awarded by the Councils as well as any possible interference or unfair competition with fund-raising activities in the private sector for support of unrestricted and specific university projects.

In view of these, and other, signposts to danger, or frustrations, CAURA would prefer to see the government offer incentives to persuade Canadian industry and business to invest in research likely to be of direct benefit to them rather than to have to attempt to induce them to support the basic research which they and we know to be the responsibility of the federal government. CAURA takes the position that the Government should commit itself to funding both the projected industrial contributions through 1990-1 as well its projected matching contributions and to use its considerable powers of fiscal persuasion to pressure industry into performing the kind of research it ought really to be sponsoring - that directly related to its own needs; such research can not and must not become part of the mandate of the granting councils. The Government is wise in its wish to persuade industry and business to invest more heavily in research but it is not clear how an industry that is reluctant to commit itself to applied research of direct relevance to its own welfare can be persuaded to invest in Council-sponsored university research.

If the Government retains the present plan of matching private sector investment in university research, we believe that the universities, despite the serious

reservations expressed above and despite our perception that it is probable that our efforts may be in vain, will do their best to cooperate and to try to make the program work <u>provided that the principal function of the granting councils to support basic research is respected and that the dangers referred to are avoided in the implementation</u>.

Here are three models that avoid these pitfalls and which would permit cooperation of the universities.

1. All private sector grants, contracts and gifts, in cash or in kind, in support of university research would be directed to the universities as at present. All or most of the matching dollars from government would go to the three Councils in proportion to their base budgets and would be for their unrestricted use as decided by each Council. A percentage of the matching funds could go to the university receiving the private sector contribution, some of which would go to support the specific research activity envisaged in the original agreement; this would provide some incentive for increased private sector interest in funding university research. This alternative is by far the most desirable and feasible alternative.

2. Should the government require that each dollar to be matched go directly to the Councils, then the private sector grants, contracts and gifts are to be arranged with a university, as in 1. above; the funds would then be sent to a Council and redirected without peer review to the University with which the arrangement was made. All or most of the matching dollars would go to the Council

handling the cheque and would be used as determined by Council. The Councils would act simply as a conduit for private sector funds which would flow directly to the universities.

3. The private sector may of course contribute to the three Councils, provided that these funds and the matching dollars be used as decided by the Councils in support of their programs and under no circumstances to support earmarked research intended for the generation of proprietary information for the donor.

SUMMARY:

1. A program whereby the Government would match funds allotted by the private sector to the federal research councils is fraught with danger both to the universities and to the granting Councils themselves.

2. CAURA would prefer that the Government abandon such a program and accept its responsibility to assure adequate funding of its research councils and to encourage Canadian business and industry to increase their investment in research related to their own commercial needs and the demands of the marketplace.

3. Should the Government proceed with its proposal to match private sector grants, the most acceptable model would be for all private sector research grants, contracts and gifts, in cash or in kind, to go directly to the universities, as at present; matching dollars would go

mainly to the three Councils in proportion to their base budgets but part could go as an incentive to the university to be used mainly to support the research described in the private sector-university agreement.

4. If for accounting purposes the Government were to insist that private sector contributions go directly to the Councils, then these should be negotiated with the universities as at present, sent to one or the other council and redirected without peer review to the university in question. Most of the matching dollars would go to the Council designated to serve as a conduit for the funds and would be used to support its programs as it may decide.

5. The private sector may of course contribute funds to the Councils <u>for use in support of their established programs</u>, such funds to be matched by the Government. We would object strenuously were such gifts to be used to generate proprietary information for the contributor.

6. We would also object strongly to any attempt to change the character of the granting councils or to redirect their primary responsibility away from what it must remain: the support of excellence in basic university research in science, engineering and scholarship.

Prepared for CAURA by Dr. J.G. Kaplan, Executive Member CAURA, Vice-President (Research), University of Alberta.

JGK/gf
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Association canadienne d'administrateurs
de recherche universitaire (ACARU)

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VEUILLEZ NOTER

Les membres de l'Association canadienne d'administrateurs de recherche universitaire (ACARU) appartiennent à trois catégories : (1) les directeurs et les administrateurs qui s'occupent d'administrer des fonds de recherche aussi bien interne qu'externe pour des bureaux ou organismes qui offrent des subventions, des contrats et des services de recherche; (2) les agents des transferts technologiques qui s'occupent des relations avec le secteur privé dans le domaine de la recherche, du brevetage et de la protection par les droits d'auteur de la propriété intellectuelle, ainsi que de la commercialisation de la recherche et des découvertes universitaires; (3) les cadres supérieurs de la recherche universitaire (vice-présidents, vice-principaux, vice-recteurs, vice-présidents associés ou adjoints, doyens et directeurs) qui s'occupent particulièrement de la recherche universitaire et de la politique de recherche sous tous leurs angles. Bien que la réponse officielle des universités aux initiatives fédérales doive venir de l'Association des universités et collèges du Canada (AUCC), qui regroupe tous les présidents d'universités, l'ACARU est exclusivement habilitée à présenter le point de vue de ceux qui s'occupent directement de la gestion et du financement de la recherche faite dans les universités.

Lors d'une réunion récente de l'ACARU à l'Université de la Colombie-Britannique (du 11 au 13 mai 1986), les cadres supérieurs de la recherche des principales universités candiennes spécialisées dans la recherche se sont livrés à des discussions vives et approfondies sur la proposition contenue dans le budget de février de M. Wilson. Le programme proposé prévoit l'appariement par l'administration fédérale des contributions que les conseils de recherche recevront du secteu rprivé pour la recherche universitaire. Le but de la discussion de l'ACARU était d'obtenir un consensus quant aux conditions qui inciteraient les universités à participer activement à un tel programme. Le présent exposé de principe décrit les problèmes possibles qui pourraient décourager la participation active de bien des universités et suggère des modèles de remplacement qui pourraient sans doute leur être acceptables.

On <u>ne trouvera pas</u> dans le présent exposé une proposition détaillée avec des définitions de termes tels que <u>secteur privé</u>, <u>financement différentiel</u>, <u>recherche</u>, etc. Il nous fera plaisir de fournir, sur demande, les définitions de ces termes contestés. Nous n'insisterons pas sur ce qu'ont souligné un grand nombre de représentants du secteur privé et des universités, à savoir que, <u>si l'État avait délibérément opté pour un programme qui remettrait à d'autres la responsabilité de financer la recherche fondamentale en sciences, en génie</u>

et pour des travaux d'érudition, il aurait probablement suggéré un plan du même genre. Nous ne présenterons pas non plus de façon détaillée de nouvelles propositions de stimulants pour le secteur privé et les universités; ici encore, nous serons heurux de le faire si on nous le demande.

Par ailleurs, nous n'hésiterons pas à souligner que, même si le secteur privé fournissait le maximum des contributions prévues par la proposition en question et que l'État accordait le maximum annuel des subventions d'appariement aux conseils pendant les cinq prochaines années, les montants offerts aux conseils seraient à peine plus élevés que ceux prévus dans leurs budgets actuels en dollars de 1986 et de beaucoup inférieurs aux sommes requises pour financer leurs plans quinquennaux; étant donné la hausse prévue du prix du matériel et des fournitures, les budgets des trois conseils de recherche à la fin de la période quinquennale (1990-1991) seront considérablement inférieurs en dollars réels à ceux de 1986-1987, même avec le maximum des contributions du secteur privé et les subventions d'appariement.

Avant d'examiner la question centrale, à savoir les conditions dans lesquelles les universités canadiennes collaboreraient vraisemblablement au programme fédéral de subventions d'appariement, nous devons souligner un autre point. Lorsque l'actuel gouvernement était dans l'opposition, il insistait, et avec raison, sur la nécessité de renforcer considérablement l'engagement du Canada envers la recherche et le développement, en vue d'assurer l'avenir économique du pays et sa présence solide dans le secteur de la technologie de pointe. M. Mulroney l'a bien écrit : "Le point de départ, pour moi, est de nature technologique. Si nous ne devenons pas des joueurs importants dans cette ligue majeure, nous allons devenir un peuple qui jouera dans le circuit junior B toute sa vie durant. Pour ce faire, nous devons, d'ici à 1985, prendre l'engagement ferme de doubler les mises de fonds publics et privés affectés à la recherche et au développement qui, avec les innovations qui en découlent, sont le pivot de notre réussite économique et nationale." (Brian Mulroney, Telle est ma position, chapitre IV : Recherche et développement, p. 60).

L'ACARU reconnaît la nécessité de restrictions financières, compte tenu de l'accumulation écrasante du déficit fédéral. Néanmoins, il est évident que la recherche n'est pas un luxe que l'on peut se permettre uniquement quand tout va bien; au contraire, un pays qui néglige la recherche et le développement dans les moments de difficultés économiques est comme une société primitive qui consomme ses semences de maïs en temps de

famine. À notre avis, l'État devrait trouver le moyen de soutenir les plans quinquennaux des trois conseils fédéraux pourvoyeurs de subventions. Un soutien approprié des programmes de recherche et de main-d'oeuvre des conseils est un investissement essentiel dans l'avenir de notre pays.

En ce qui concerne la propostion d'appariement des contributions du secteur privé à la recherche universitaire financée par les conseils, les membres de l'ACARU se sont clairement entendus sur les points suivants :

1. Le programme d'appariement pourrait présenter de graves dangers tant pour les universités que pour les trois conseils, selon les règles que l'État imposera et qui nous étaient inconnues au moment de la rédaction du présent mémoire. Voici quelques-uns de ces dangers possibles :

a) Délaissement graduel de la recherche fondamentale en sciences, en génie et pour des travaux d'érudition de la part des trois conseils, qui se préoccuperont davantage de la R-D étroitement appliquée et visant à produire de l'information brevetée et utile pour une entreprise industrielle ou commerciale en particulier en échange d'une contribution financière. Les universités s'opposeront à toute mesure qui pourrait conduire à une telle transformation des conseils, car le soutien de la recherche fondamentale doit demeurer leur fonction; la R-D appliquée dépend carrément d'un financement approprié de la recherche fondamentale, une leçon qu'un pays ne peut négliger qu'à ses risques.

b) Concurrence destructrice entre les conseils en vue d'obtenir des dons du secteur privé, bien qu'aucun des conseils ne puisse probablement obtenir une part raisonnable du financement des entreprises industrielles et autres du secteur privé.

c) Interférence dans les activités habituelles de souscription des universités auprès du secteur privé ainsi que dans la recherche sous contrat effectuée normalement par les universités pour le compte d'entreprises industrielles et commerciales. Les universités résisteront en particulier à l'introduction d'une recherche contractuelle sous forme de subventions accordées par les conseils ainsi qu'à toute possibilité d'interférence ou de concurrence déloyale dans les activités de souscription auprès du secteur privé en vue d'obtenir un soutien sans restriction de projets universitaires particuliers.

Compte tenu de ces signes de danger, de ces frustrations ou de toute autre possibilité d'embarras, l'ACARU préférerait voir l'État offrir des stimulants qui persuaderaient les entreprises industrielles et commerciales canadiennes d'investir dans la recherche dont elles pourraient directement tirer avantage, plutôt qu'essayer de les convaincre de soutenir la recherche fondamentale qui relève, comme tout le monde le sait, de l'administration fédérale. De l'avis de l'ACARU, l'État devrait s'engager à financer tant les contributions industrielles projetées jusqu'en 1990-1991 que ses contributions d'appariement projetées et à utiliser ses pouvoirs considérables de persuasion fiscale pour contraindre l'industrie d'effectuer le genre de recherche qu'elle devrait vraiment financer, c'est-à-dire celle qui répond directement à ses propres besoins; cette recherche ne peut et ne doit pas faire partie du mandat des conseils pourvoyeurs de subventions. Il est sage pour l'État de souhaiter persuader les entreprises industrielles et commerciales d'investir plus intensément dans la recherche, mais il n'est pas clair comment une entreprise qui hésite à s'engager dans de la recherche appliquée dont elle peut tirer des avantages directs pourrait être persuadée d'investir dans de la recherche universitaire parrainée par un conseil de recherche.

Si l'État conserve son projet actuel d'appariement des investissements du secteur privé dans la recherche universitaire, nous croyons que les universités, malgré les sérieuses réserves exprimées plus haut et notre impression que nos efforts seront probablement vains, feront de leur mieux pour collaborer et essayer de faire fonctionner le programme, pourvu qu'on respecte la fonction principale des conseils pourvoyeurs de subventions et que, dans la mise en oeuvre du programme, on évite les dangers mentionnés précédemment.

Voici trois modèles qui éviteraient ces embûches et permettraient la collaboration des universités.

1. Tous les dons, contrats et subventions du secteur privé, en espèces ou en nature, destinés à soutenir la recherche universitaire, iraient aux universités comme à l'heure actuelle. La totalité ou presque des subventions d'appariement de l'État irait aux trois conseils proportionnellement à leur budget de base et serait utilisée à la discrétion de chaque conseil. Un pourcentage des fonds d'appariement pourrait aller à l'université qui reçoit la contribution du secteur privé, et une partie de ce pourcentage servirait à soutenir l'activité de recherche particulière envisagée dans l'accord initial; ceci encouragerait d'une certaine façon le secteur privé à financer davantage la recherche universitaire. Cette solution est de loin la plus souhaitable et la plus facilement réalisable.

2. Si l'État exige que chaque dollar devant être apparié aille directement aux conseils, alors les subventions, contrats et dons du secteur privé devront faire l'objet d'un arrangement avec l'université intéressée, comme dans 1. ci-dessus; les fonds seraient ensuite envoyés à un conseil et réacheminés, sans examen par les pairs, à l'université avec laquelle l'accord a été conclu. La totalité ou presque des sommes d'appariement irait au conseil qui s'occupe du chèque et serait utilisée à la discrétion du conseil. Les conseils serviraient simplement de canal pour acheminer directement les fonds du secteur privé aux universités.

3. Le secteur privé peut évidemment accorder des contributions aux trois conseils, pourvu que ces derniers puissent à leur discrétion se servir des fonds en question ainsi que des sommes d'appariement pour financer leurs propres programmes et en aucun cas pour soutenir de la recherche destinée à produire de l'information brevetée pour le donateur.

RÉSUMÉ

1. Un programme qui permettrait à l'État d'apparier les fonds fournis par le secteur privé aux conseils fédéraux de recherche constituerait un danger tant pour les universités que pour les conseils pourvoyeurs de subventions.

2. L'ACARU préférerait que l'État abandonne un tel programme et accepte sa responsabilité, qui est d'assurer un finacement suffisant de ses conseils de recherche ainsi que d'encourager les entreprises commerciales et industrielles canadiennes à accroître leurs investissements dans la recherche liée à leurs propres besoins commerciaux et aux demandes du marché.

3. Si l'État décidait de mettre en oeuvre sa proposition d'appariement des contributions du secteur privé, la solution la plus acceptable serait que tous les dons, contrats et subventions de recherche du secteur privé, en espèces ou en nature, aillent directement aux universités, comme à présent; les sommes d'appariement iraient principalement aux trois conseils, proportionnellement à leur budget de base, mais une partie pourrait être accordée comme stimulant aux universités concernées, qui devraient s'en servir principalement pour appuyer la recherche décrite dans l'accord conclu avec l'entreprise privée.

4. Si, pour des raisons de comptabilité, l'État devait insister pour que les contributions du secteur privé aillent directement aux conseils, celles-ci devraient faire l'objet de négociations avec les universités, comme à l'heure actuelle, être envoyées à

l'un ou l'autre des conseils, puis, être réacheminées, sans examen par les pairs, aux universités intéressées. La plus grande partie des sommes d'appariement irait au conseil désigné comme intermédiaire des fonds, et ce dernier s'en servirait à sa discrétion pour financer ses propres programmes.

5. Le secteur privé peut évidemment accorder des contributions aux conseils comme soutien à leurs programmes établis, et ces fonds seront appariés par l'État. Cependant, nous nous opposerions énergiquement à ce que ces dons servent à produire de l'information brevetée pour les donateurs.

6. Nous nous opposerions aussi fermement à toute tentative de modifier le caractère des conseils pourvoyeurs de subventions ou d'éloigner ces derniers de leur responsabilité principale, qui doit rester la suivante : encourager l'excellence dans la recherche universitaire fondamentale en sciences, en génie et pour des travaux d'érudition.

Mémoire préparé par l'ACARU par M. J.G. Kaplan, membre du conseil d'administration de l'ACARU, vice-président à la recherche, Université de l'Alberta.

21 mai 1986

DOCUMENT: 830-220/012

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Executive Summary for CAUT Research and Development Document

Canadian Association of University Teachers

June 8-10, 1986
Winnipeg, Manitoba

caut
acpu

canadian association of university teachers

association canadienne des professeurs d'université

May 30, 1986

EXECUTIVE SUMMARY FOR CAUT
R&D DOCUMENT

There is widespread recognition that Canada must increase its research and development investment, that universities will have to play a major role in this expansion, and that the postsecondary education sector has suffered from a decade or more of underfunding. Nevertheless, the real problems of research and higher education are still not being addressed fully by governments.

Forums such as this one are welcome but will only be successful if rhetoric is downplayed and federal-provincial infighting is eliminated so that the real issues can be fully discussed.

CAUT believes that both levels of government have been pursuing, and continue to pursue, the wrong policies in relation to research and higher education. There is no clear national policy in either area. This has resulted in a tendency to reduce deficits using cutbacks in these areas. The federal transfers for postsecondary education under EPF have been cut a number of times. The provinces have underfunded the university system since the early 1970's. The federal granting councils have not been given the funds necessary to carry out their missions as outlined in their respective five year plans.

There have been many warnings about the problems besetting research and higher education. These include Dr. A.W. Johnson's report to the Secretary of State, the Wright Report, and the Report of the Study Team on Education for the Nielsen Report.

These reports, and other studies, have shown the strong link between the funding of universities and their research capabilities. They have stressed the importance of long-range planning and funding for the federal granting councils and the problems which arise because the Councils do not pay the full costs of research, including the indirect support costs.

While Canada is underfunding its higher education system, other countries are vastly increasing support for research and postsecondary education. In the United States, for example, thirty-six states increased funding to universities at rates higher than any Canadian province between 1983 and 1985. Twenty states, with a combined population of 99 million, increased funding at rates at least 50% higher than any Canadian province during that period.

1001-75 Albert, Ottawa, Ontario, K1P 5E7 • (613) 237-6885

Given the importance of the federal granting councils in the support of university research, the research community was most unhappy with the freezing of council funding for the next four years. This was particularly so when it had been disguised as a $300 million increase to the councils by an accounting trick. CAUT estimates that with even a modest rate of inflation, the councils will have 15% to 20% less funding in real terms at the end of this period.

It must be stressed that it is not only natural science and medical research that is at issue. The proposed five year plan of SSHRC clearly indicates the range of practical and applied research funded by that Council. These include the study of foreign countries, economic trade and development, labour relations, law, and business management, all of which are important areas of research for a trading nation like Canada.

Even under the most optimistic scenario, the three federal granting councils will receive only minimal funding increases in real terms. Much of this money will be "soft money" with no guarantee that it will continue from year to year. More realistically, the granting councils' budgets will decrease in real terms over the next four years. In either case, the councils will receive hundreds of millions of dollars less than is required to carry out their respective five-year plans.

RECOMMENDATIONS

CAUT urges that:

1. The federal granting councils be funded at the levels outlined in their respective five year plans.

2. The private sector matching grant scheme be limited to 2% of the base budget (one third the current federal proposal). This scheme should operate for three years. At the end of this period, it should be reviewed with an opportunity for public input.

3. The definition of private sector funds be widened to include private non-profit funding. In particular, this would allow for matching funds for non-profit sector funding of the Medical Research Council.

4. Revenue Canada should establish a method of prompt advanced rulings on the status of contributions to ensure that private sector donors receive full credit for their donations under the Income Tax Act.

5. Donations in "kind" should be treated as cash donations.

6. The matching grant programme should be regulated by a minimum of bureaucratic procedure. It should not be necessary for all matching grant donations to be channelled through the granting councils exclusively. It should be possible to arrange that donations could be made directly to universities, with the councils acting as reporting agencies.

7. The universities should be adequately funded to allow them to perform both their teaching and research functions at a level comparable to our major trading competitors.

8. Research grants should pay the full costs of research, including the indirect costs to the universities.

9. The federal government should not proceed with Bill C-96 which would cut the entitlements under EPF.

10. There should be a first ministers' meeting on postsecondary education and research at the earliest possible date.

DOCUMENT: 830-220/012

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

<u>Résumé du document de l'ACPU sur la recherche-développement</u>

Association canadienne des professeurs d'université

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

CANADIAN ASSOCIATION OF
UNIVERSITY TEACHERS

ASSOCIATION CANADIENNE
DES PROFESSEURS
D'UNIVERSITÉ

Le 30 mai 1986

**RÉSUMÉ DU DOCUMENT DE L'ACPU
SUR LA RECHERCHE-DÉVELOPPEMENT**

En général, on s'accorde à dire que le Canada doit consentir davantage de crédits à la R-D, que les universités devront jouer un rôle de premier plan dans cette expansion, et que, depuis une dizaine d'années, le secteur de l'enseignement postsecondaire a souffert du sous-financement. Malgré cela, les gouvernements ne se sont toujours pas attaqués aux véritables problèmes liés à la recherche et à l'enseignement supérieur.

Bien qu'opportunes, des conférences telles que celle-ci ne porteront fruit que si l'on évite les grandes déclarations et que l'on passe outre aux querelles fédérales-provinciales, de manière à discuter à fond des dossiers clés.

L'ACPU estime que les deux ordres de gouvernement se sont fourvoyés dans leur politique respective touchant la recherche et l'enseignement supérieur. Ni l'un ni l'autre de ces secteurs ne bénéficie d'une politique nationale bien définie. Par conséquent, on a tendance à combler les déficits en y pratiquant des coupures. Les paiements de transfert destinés à l'enseignement postsecondaire en vertu des mesures touchant le Financement des programmes existants ont été réduits à plusieurs reprises. Depuis le début des années 70, les crédits que les provinces accordent aux universités sont nettement insuffisants. Les conseils de subventions fédéraux n'ont pas reçu les fonds nécessaires pour remplir leur mandat tel que défini dans leurs plans quinquennaux respectifs.

Les problèmes liés à la recherche et à l'enseignement supérieur ont été soulevés à plusieurs reprises, notamment dans le Rapport Johnson au Secrétariat d'État, le Rapport Wright, et le rapport du Groupe de travail sur l'éducation faisant partie intégrante du Rapport Nielsen.

Ces documents, et plusieurs autres, ont montré la forte interdépendance entre le financement des universités et leur capacité de recherche. Ils ont souligné l'importance d'une planification et d'un financement à long terme pour les conseils de subventions fédéraux, invoquant les problèmes que cause l'incapacité de ces derniers de couvrir l'ensemble des coûts de la recherche, et notamment les frais de soutien indirects.

Tandis que le Canada se montre parcimonieux envers son système d'enseignement supérieur, d'autres pays augmentent considérablement les crédits affectés à la recherche et à l'enseignement postsecondaire. Aux États-Unis, par exemple, entre 1983 et 1985, trente-six États ont augmenté les fonds consentis aux universités à des taux supérieurs à ceux de n'importe laquelle des provinces canadiennes. Vingt d'entre-eux, totalisant une population de 99 millions de personnes, ont accru leur financement à des taux au moins 50 p. 100 plus élevés que ceux des provinces canadiennes.

Étant donné l'importance de l'aide accordée par les conseils de subventions fédéraux à la recherche universitaire, les chercheurs ont très mal accueilli le gel des crédits pour les quatre prochaines années, et ce d'autant plus qu'une subtilité comptable maquillait ce gel en une augmentation de 300 millions de dollars au profit des conseils. L'ACPU estime que même avec un taux d'inflation modeste, les conseils auront subi une réduction de 15 à 20 p. 100 de leurs crédits à la fin de ces quatre années.

Soulignons que ce n'est pas seulement la recherche en sciences naturelles et en médecine qui est en jeu. Le projet de plan quinquennal du CRSH indique clairement les travaux de recherche pratique et appliquée subventionnés par ce Conseil. Mentionnons notamment l'étude des pays étrangers, le commerce et le développement économique, les relations du travail, le droit et la gestion commerciale, autant de secteurs importants pour un pays commerçant comme le Canada.

Même dans les conditions les plus favorables, les trois conseils de subventions fédéraux ne recevront que des augmentations minimales en termes réels. La majorité des crédits accordés seront des " fonds de faveur ", sans garantie de renouvellement d'une année à l'autre. Selon une projection plus réaliste, le budget des conseils de subventions diminuera au cours des quatre prochaines années. Dans les deux cas, ils seront privés de centaines de milliers de dollars nécessaires à la réalisation de leurs plans quinquennaux respectifs.

RECOMMANDATIONS

L'ACPU recommande fortement :

1. Que le financement des conseils de subventions fédéraux soit conforme aux taux établis dans leurs plans quinquennaux respectifs.

2. Que le régime de subventions jumelées du secteur privé soit limité à 2 p. 100 du budget de base (soit un tiers de ce que le fédéral propose actuellement) et qu'il soit mis en oeuvre pour une période de trois ans; après quoi il serait réévalué, notamment en invitant le public à se prononcer à ce sujet.

3. Que la définition des fonds du secteur privé soit élargie de manière à inclure le financement des organismes sans but lucratif. Cela permettrait notamment l'octroi de subventions jumelées pour le financement sans but lucratif du Conseil de recherches médicales.

4. Que Revenu Canada adopte un processus de décisions anticipées quant à la nature des contributions afin d'assurer que les donateurs du secteur privé bénéficient pleinement des dégrèvements prévus à la Loi de l'impôt sur le revenu.

5. Que les dons de biens ou services soient considérés au même titre que les dons en espèces.

6. Que les procédures administratives touchant le programme de subventions jumelées soient allégées le plus possible. Les dons consentis en vertu de ce programme ne devraient pas être acheminés exclusivement par le biais des conseils de subventions, mais devraient pouvoir être versés directement aux universités, les conseils faisant office d'organismes déclarants.

7. Que les universités se voient accorder des fonds suffisants pour remplir leurs fonctions d'enseignement et de recherche de façon comparable à nos principaux partenaires commerciaux.

8. Que les subventions à la recherche couvrent entièrement les coûts liés aux travaux, y compris les frais indirects encourus par les universités.

9. Que le gouvernement fédéral renonce au projet de loi C-96 qui réduirait les droits accordés en vertu des mesures de Financement des programmes existants.

10. Qu'une conférence des premiers ministres sur l'enseignement postsecondaire et la recherche soit convoquée dans les meilleurs délais.

DOCUMENT: 830-220/013

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Development of a National Science and Technology Policy

The Canadian Chamber of Commerce

June 8-10, 1986
Winnipeg, Manitoba

THE CANADIAN CHAMBER OF COMMERCE
200 ELGIN STREET · SUITE 301 · OTTAWA, ONTARIO K2P 2J7 · (613) 238-4000 · TELEX: 053-3051

OFFICE OF THE PRESIDENT

March 24, 1986

Hon. Frank Oberle, P.C.,M.P.
Minister of State for
Science and Technology
C.D. Howe Building
235 Queen Street
8th Floor - West Tower
Ottawa, Ontario
K1A 1A1

Dear Mr. Oberle,

Thank you for the time which you spent meeting with the Chamber's Research and Development Committee on March 13th. We are pleased to hear that more initiatives are planned regarding implementation of reforms suggested in the Wright Report regarding government intramural research. The preparation of a science policy paper by the Government is also welcomed by the Chamber, and we hope to meet with you again when this document is issued.

Now that the Government is actively seeking industrial support for university research, we have written to the Social Sciences and Humanities Research Council to attempt to establish a closer liaison (copy attached). Our Research and Development Committee members are already quite familiar with the Natural Sciences and Engineering Research Council and, in the months ahead, we will be discussing with them how we may work better together. We have also met with the Association of Universities and Colleges of Canada to establish closer linkages, and we will keep you informed of our progress in these meetings.

Concerning the trade deficit in high technology goods, we too share your deep concern. The solutions are not obvious, and a meaningful analysis to develop a strategy to address this problem would require a substantial effort, perhaps a government-industry task force. We would be pleased to recommend members of the Chamber to work with the government should you wish to explore this major economic problem in the near future.

Once again, thank you for meeting with our Research and Development Committee. We look forward to further meetings with your Ministry in the near future.

Sincerely,

Roger B. Hamel

RBH/haw
attachment

THE CANADIAN CHAMBER OF COMMERCE

200 ELGIN STREET · SUITE 301 · OTTAWA ONTARIO K2P 2J7 · (613) 238-4000 · TELEX 053-3051

OFFICE OF THE PRESIDENT

August 13, 1985

The Hon. Thomas Siddon, P.C., M.P.
Minister of State for
Science and Technology
Room 119, East Block
House of Commons
Ottawa, Ontario K1A 0A6

Dear Minister,

Further to our May 13 meeting, the Chamber's Research and Development Committee welcomes this opportunity to comment on university research, funded through the Natural Sciences Engineering and Research Council.

In order to compete and prosper in a highly technological and competitive world, Canada needs a superior innovative capacity and a continuing adequate supply of manpower with excellent capability. This can only be achieved by assuring the quality and research capability of our university system. This is critical to fulfilling the manpower and research and development expectations of government, industry and society as a whole. Action to foster, develop and enhance the capabilities of our universities is essential so as to ensure the country's and our children's future.

Within the business community, there is growing concern that the financial squeeze on university funding may interfere with the ability of universities to respond to the demands of our society. Universities lack the funds to replace aging faculty as well as equipment -- a replacement that is a prerequisite to the education of students and scientists in the next 5 to 15 years.

Increasingly, universities are finding it difficult, at times impossible, to meet the demands made on them for research and development because of space limitations, obsolete facilities and shortage of faculty and support staff. Enrollments are higher, and in real terms, funding per student has dropped by 20 percent or more in the last decade in many jurisdictions.

The Chamber recognizes the severe budgetary constraints facing the government and fully supports efforts to reduce spending in order to improve our country's deficit and debt position. Nevertheless, we believe that within the limits imposed by the existing budgetary constraints, university funding should be recognized as a priority area. In particular, we recommend:

- That these problems be addressed in federal/provincial negotiations on funding of post-secondary education, with due attention to the fact that universities must have adequate support for research programs if they are to meet governmental, industrial and societal needs for research and highly qualified manpower.

- That the private sector, labour and universities be involved on an on-going basis in negotiations on university funding and on technological and scientific goals of the nation. Planning should be on a long-term basis and abrupt changes should be avoided.

- That the need for quality in education and research be fully respected in the negotiations, even in the face of current financial constraints facing governments.

- That, in order to maintain the supply of scientists and engineers needed to fulfill research and development targets, graduate and postgraduate training at the universities be strengthened by the provision of appropriate support for equipment and facilities.

- That special incentives be considered to attract the most gifted students to the highest level of their profession. Identification and support of leadership and management potential is especially important.

- That foreign students, especially those in graduate programs, not be discouraged, for instance by higher fees, from coming to Canada.

- That technology transfer programs between universities and industry be encouraged.

The private sector recognizes the need for financial constraints and sacrifices. However, we believe that the development of scientific research and development at the universities must be supported at a very high level. The apparent short-term savings that might accrue through continued underfinancing would be offset by the tragedy that would almost inevitably follow.

Sincerely,

Roger Hamel

cc: The Hon. Walter McLean, Secretary of State
The Hon. Sinclair Stevens, Minister of Regional Industrial Expansion
The Hon. Michael Wilson, Minister of Finance
Provincial Ministers of Education

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OFFICE OF THE PRESIDENT

August 13, 1985

The Hon. Thomas Siddon, P.C., M.P.
Minister of State for
Science and Technology
Room 119, East Block
House of Commons
Ottawa, Ontario K1A 0A6

Dear Minister,

Further to our May 13 meeting, the Chamber's Research and Development Committee is pleased to have this opportunity to comment on science procurement practices of the Department of Supply and Services.

The Committee's key recommendations are summarized as follows:

1. The Department of Supply and Services should maintain its existing responsibility for scientific procurement in order to ensure greater uniformity. However, regulations governing scientific procurement should be revised in recognition of the special nature of this form of procurement.

2. Internal procedures governing the issuance of contracts should be revised and streamlined in an effort to shorten the time it takes for the Department to issue a contract.

3. Technologies, patents, copyrights and/or product innovations developed by the private sector with assistance from the government should be owned by the performing industry -- and not by the government.

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The Hon. Thomas Siddon, P.C., M.P.
Page 2
August 13, 1985

4. To assist small businesses in bidding for and negotiating contracts, an independent ombudsperson's office should be established.

5. In order to alleviate the problem of meeting fixed deadlines for bids, the Department's regional offices should be empowered to date-stamp bids on behalf of the Ottawa office.

Our more detailed comments on the points raised above, as well as on other issues of concern to the Committee, are discussed below.

Role of DSS in Scientific Procurement

The existing procurement procedures of DSS have been creating difficulties for our members. The root cause of the problem is the fact that these procedures fail to recognize sufficiently the differing nature of R and D procurement -- as opposed to the procurement of standard goods and services.

We believe that measures should be taken to improve the existing system. We suggest that the Science and Professional Services Directorate of DSS be given the authority to exempt science contracts from terms and conditions which are not appropriate to scientific procurement. Efforts to develop special regulations for such procurement must continue. Moreover, the Director General of the Directorate must have the discretionary authority to interpret these regulations.

We strongly feel that DSS should maintain its responsibility for scientific procurement. This will ensure greater uniformity in the procurement system.

The establishment of a totally new procurement system, with responsibility resting in other departments, will create a host of anticipated and unanticipated problems. We note that a number of government departments and agencies are already responsible for their own procurement -- these include the National Research Council, the Canadian International Development Agency, Health and Welfare as well as Consumer and

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Corporate Affairs. Based on the experience of our members, direct procurement by these bodies has not produced better results. In some instances it has taken longer to negotiate contracts than it has with DSS. Moreover, the DSS route has tended to offer greater access to potential bidders.

Another major concern is that each procuring department and agency follows its own procurement practices. This can be confusing for business and can create roadblocks to bidding. Therefore, we recommend that where procurement is done directly by government departments and agencies, the same procedures and practices as applied by DSS be adopted.

Scientific Procurement Procedures

A major concern to business is the length of time it takes for DSS to issue a contract. In our experience, the contracting departments tend to respond relatively quickly in reviewing the scientific content of a proposal. However, the DSS process of translating this into a written contract as a rule takes longer than is warranted -- particularly in view of the fact that much of the contract language is standardized.

We recommend that the various steps through which a contract passes internally within DSS be reviewed and streamlined. The goal should be to draft contracts in one or two weeks where standard language is used and where a statement of work approved by both the client department and the company is provided. Currently, it takes about 20 weeks to respond to such a standard situation, particularly for larger contracts. In some circumstances it can take a year to complete the process. We suggest that the Department consider: (a) applying strict time limits for processing contracts; and (b) establishing procedures to monitor the time it takes to process proposals to ensure compliance with established time frames.

Right to Intellectual Property

The government retains the right to intellectual property in research contracts in which DSS participates on a shared-cost basis with private sector companies. We note that such innovations normally build on a base of expertise established in industry, with government assistance only partially covering the real costs of development.

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We strongly believe that technologies, patents, copyrights, and/or product innovations developed by the private sector with assistance from the government -- under either grant or contract agreements -- should be owned by the performing industry.

This approach would promote the development of the technology which would benefit all Canadians.

"Make or Buy" Policy

The "make or buy" policy, which the Chamber has endorsed enthusiastically, was introduced about ten years ago. We note, with disappointment, that government departments have been slow to adopt this policy. One indication of this: The percentage of R and D activities carried out under contract has not increased in recent years.

We observe that public servants responsible for R and D program delivery are reluctant to contract out work. In part, this occurs because the procurement rules favour internal R and D activity. For instance, cost comparisions of in-house versus outside activity are generally unrealistic, with in-house cost estimates being low. Yet, these cost comparisons are used to justify performing the activity internally. In other instances, government scientists are unwilling to support external projects because of the administrative effort that would be required of them. Some scientists view such proposals as competing with their own research. Given these considerations, there is little incentive for government employees to promote contracting out of activity.

We recommend that the implementation of "make or buy" policy be reviewed and systems established that are supportive of contracting out to the private sector. One approach: A specific target ratio should be set for in-house versus contracted-out activities, and this ratio should be in line with that of other countries.

Unsolicited Proposals

The Chamber is generally very supportive of the unsolicited proposals program which arose out of the "make or buy" policies. However, we feel that the program could be improved so that it is even more supportive of private sector research and development activity.

For a proposal to be accepted, a key requirement is that the technology being suggested should be of use to the sponsoring client department. However, in some instances, a proposal might be worthwhile to the private sector company even though the technology is not needed by government. Proposals which do not have a departmental sponsor should be considered for funding by the National Research Council.

Negotiation of Overhead Rates

DSS negotiations with industry on overhead rates are very time consuming. To simplify the procedure, business should be allowed to apply rates based on market forces, when competitive bidding is involved. In other situations, rates charged to the government should be in line with those a company normally charges its other clients for work of similar scope and nature.

Another concern is that the system tends to be arbitrary. This is because in some circumstances DSS can request an audit of costs with a view to changing the agreed-upon rates. We note that currently conflicting language is used in the government's "fixed-price" contracts. At the very least, the cost of such audits should be automatically considered to be a direct cost of the contract.

"Ombudsperson's Office"

It has been our observation that too often small firms experience difficulties when bidding and negotiating. The establishment of an independent "ombudsperson's" office to assist small business people would help alleviate this problem. An ombudsperson would be particularly helpful in instances where disputes arise between the private sector bidder and DSS. We emphasize that the staffing of such an office should be done through reallocating personnel from elsewhere in the Department -- and not by adding new staff.

Acceptance of Bids by Regional DSS Offices

Meeting fixed deadlines for bids under the current procedures represents another area of concern to business.

It is not unusual for bidders to receive proposals for bids only several days before the deadline. When this happens, there is very little time available to prepare a bid and to ensure that it is received on time by DSS. In our view, a number of measures could be implemented to facilitate the bid submissions process.

DSS has a network of regional offices across Canada. We recommend that these offices, in addition to date-stamping bids for contracts which they issue, provide the same service on behalf of the Ottawa office. The requirement that bids be submitted directly to Ottawa places regional bidders at a significant competitive disadvantage.

When couriers are used to deliver bids to Ottawa, they are not permitted access to the bid opening room in DSS. Because of this, several additional days are lost to the bidder as the bid makes its way from reception to the bid room. We recommend that a system be established to allow couriers direct access to the bid room.

Pre-Qualification Process

We compliment the Department for establishing and following the existing pre-qualification procedures. The pre-qualification process both simplifies and speeds up the bidding process. We encourage the Department to promote wider use of this process. In our view, wider use would encourage development of technological capability in the private sector.

Competition from Government-Supported Organizations and Universities

In our view, DSS should make every effort to emphasize its policy of not accepting bids from public sector organizations -- where private sector capability exists. We suggest that the policy be monitored periodically to ensure that it is being adhered to to the maximum extent possible.

We hope that the views expressed above will be of assistance to you. We would be pleased to elaborate further on the points raised with either you or your officials.

Sincerely,

Roger Hamel

cc: Hon. Harvie André, Minister
Department of Supply and Services

Hon. Robert de Côtret, President
The Treasury Board

THE CANADIAN CHAMBER OF COMMERCE
200 ELGIN STREET · SUITE 301 · OTTAWA, ONTARIO K2P 2J7 · (613) 238-4000 · TELEX: 053-3051
OFFICE OF THE PRESIDENT

October 9, 1984

The Hon. Thomas Siddon, P.C., M.P.
Minister of State for Science
and Technology
Room 119, East Block
House of Commons
Ottawa, Ontario
K1A 0A6

Dear Mr. Minister,

The Research and Development Committee of the Canadian Chamber of Commerce has followed with great interest the work of the Task Force on Federal Policies and Programs for Technology Development. The Committee has made several presentations to the Task Force on behalf of the Chamber and is pleased to have this opportunity to comment on the recently released report of the Task Force.

The Report promotes greater involvement of the private sector in government R and D activities and greater reliance on market forces to shape Canada's R and D effort. We fully endorse this approach since we believe that greater reliance on the private sector and on market forces would produce a better utilization of financial and human resources devoted to R and D. Our comments on specific proposals are summarized below:

Greater Involvement of the Private Sector in Government R and D

The Report suggests that there should be more private sector involvement in R and D activities carried out in government laboratories. We believe that such private sector involvement would bridge the communications gap between the industrial and the government R and D communities. The result should be R and D activity that is more supportive of Canada's existing and future industrial activity. Particularly important from the efficiency and relevancy point of view is greater private sector input in the planning of new in-house R and D activities.

Private sector representatives should be appointed to the boards of directors of the various federal laboratories. In addition, the mandates of government laboratories need to be reviewed on a periodic basis by specially established peer groups. We strongly believe that in order to be effective, the appointees to both the boards of directors and the peer groups must possess appropriate expertise and should, therefore, be selected to serve on the basis of merit. Moreover, these appointments should be made only after consulting with business and/or professional associations as well as labour. The Chamber would welcome the opportunity to suggest names of people from the private sector research community.

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Contracting Out of In-house R and D

The Report recommends that in-house R and D should be restricted to cases "where there is a need for secrecy or neutrality, or when contracting out is not cost-effective in the long run". We welcome this approach and believe that much more contracting out of in-house R and D activities needs to take place.

One approach to contracting out of in-house R and D might be through the unsolicited proposal program administered by the Department of Supply and Services. The DSS program is a good example of how the private sector can be utilized to provide some direction to public R and D spending.

Review of Government Laboratories

We believe that there should be an independent and detailed review of the mandates of government laboratories. The reviewing body should be asked to recommend that where mandates of government laboratories are no longer suited to today's environment, they be either changed or the laboratory be wound down.

Greater Reliance on Market Forces in Shaping R and D Activity

The Chamber agrees with the Task Force's suggestion that the tax system should be used to support R and D because this approach would allow the marketplace to pick and choose suitable R and D projects. This should encourage the development of marketable products and processes.

Government Industry Support Programs

The Task Force's Report suggests that many of the existing industry support programs should be either discontinued or greatly modified. It has been our observation that many of these programs have indeed outlived their usefulness. Therefore, we fully support this recommendation.

We believe that it would be useful to undertake a cost/benefit analysis of these programs to ensure that they reflect today's needs. In this regard, we note the recent Income Tax Act changes which provide a new opportunity for companies, including the smaller companies, to raise financing for R and D activity. As a general rule, we believe that this approach is preferable since it is based on market forces rather than on bureaucratic decision-making.

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Government Procurement of Technology Intensive Products

We concur with the Report's observation that there is a general lack of interest shown by government departments in the purchase of newly-developed Canadian products. The purchase of high technology products from Canadian suppliers should be encouraged whenever costs are competitive. We believe that this should be particularly applicable to departments and/or government agencies with a strong technological expertise (and in situations where the amount of money at risk is reasonable).

Support of University R and D

We welcome the idea proposed by the Task Force to extend tax credits for R and D to universities where the R and D is supportive of industry. This approach might lead to a better exchange of information between universities and industry. At present, the links between the two sectors are relatively weak. There is only one formal mechanism for the transfer of technology between universities and industry, and that is the National Research Council's PILP program. Even here, however, problems exist since the system can be cumbersome and is too often administered by people with insufficient market experience and knowledge.

We also support the Report's recommendation that more funding for R and D be directed to universities. We believe that universities will play an increasingly important role in research and development, and this fact should be recognized in government funding of R and D activity. The goal should be to direct a greater overall share of R and D spending to universities. Therefore, any increases in federal spending must not be accompanied by cuts of similar amounts by the provinces.

We note that some of the funding should be directed to establishing and promoting "Centres of Excellence" in order to focus R and D activity and avoid costly duplication.

Definition of R and D

We support the suggestion made by the Task Force to extend the definition of R and D for income tax purposes to make it more compatible with that used in the United States, thereby effectively eliminating the "wholly attributable" rule used in Canada. It must be recognized that most small companies cannot afford to employ full-time staff in R and D. Therefore, often R and D is performed by staff on a part-time basis using existing facilities. These realities should be allowed for in our tax system.

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Transfer of IRDP to the National Research Council

Traditionally the National Research Council has been involved in basic research. We believe that this is an appropriate role for the Council and question the advisability of the Task Force's recommendation to transfer the technology-development portions of the IRDP from DRIE to the Council. Unlike DRIE, the Council has limited experience with industrial research. Therefore, we feel that the status quo should be maintained in this area.

Role of the Chief Science Advisor

We believe that this position is an important one and should continue to exist. To be effective, we suggest that the Science Advisor strive to obtain maximum input from the broader academic and industrial scientific communities, in addition to obtaining the views of the various government departments. The Science Advisor should be accessible to people outside of government.

We would be pleased to explore further the ideas expressed in this letter with either you and/or your officials. A small delegation of the Chamber's Research and Development Committee would be pleased to meet with you in Ottawa, at your convenience.

Sincerely,

S. F. Hughes

:RD

DOCUMENT: 830-220/013

CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

L'élaboration d'une politique nationale des sciences et de la technologie

La Chambre de commerce du Canada

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

Cabinet du Président

La Chambre de commerce du Canada
200, rue Elgin, Ottawa K2P 2J7

le 24 mars 1986

L'hon. Frank Oberle, C.P., Député
Ministre d'État chargé des
Sciences et de la Technologie,
Édifice C.D. Howe,
225, rue Queen,
8e étage, Tour de l'Ouest,
Ottawa, Ont. K1A 1A1

Monsieur le Ministre,

Je vous remercie d'avoir bien voulu consacrer de votre temps à l'entretien du 13 mars avec le Comité de la recherche et du développement auprès de la Chambre de Commerce du Canada. Nous sommes heureux d'apprendre qu'on prépare d'autres initiatives pour la mise en oeuvre des réformes proposées par le Rapport Wright au sujet des travaux internes de recherche du secteur public. La Chambre de Commerce est également satisfaite de la préparation, par le gouvernement, d'un exposé sur la politique des sciences, et nous espérons que vous voudrez bien nous rencontrer à nouveau après la parution de ce document.

Comme le gouvernement s'efforce d'obtenir le soutien des industries à la recherche universitaire, nous avons écrit au Conseil de recherches en sciences humaines (ci-joint copie de la lettre) pour nouer des relations plus étroites. Les membres de notre Comité de la recherche et du développement connaissent bien les activités du Conseil de recherches en sciences naturelles et en génie et, au cours des mois qui viennent, nous débattrons avec ce Conseil les meilleurs moyens de concerter nos efforts. Nous nous sommes également entretenus avec l'Association des collèges et universités du Canada, en vue d'établir des liens plus étroits, et nous vous tiendrons informé du suivi de ces entretiens.

Nous partageons les préoccupations que vous cause le déficit de la balance commerciale au titre des produits de pointe. On n'aperçoit pas de solution évidente, et il faudrait effectuer un effort substantiel, peut-être créer un groupe de travail commun secteur public-industrie, pour effectuer l'analyse nécessaire à l'élaboration d'une stratégie de correction de ce déséquilibre. Au cas où vous decideriez d'explorer ce problème d'importance majeure dans un proche avenir, nous serions heureux de recommander des membres de la Chambre de commerce pour oeuvrer avec les responsables de l'Administration.

En espérant prendre contact à nouveau avec votre Ministère, je vous prie d'agréer, Monsieur le Ministre, l'assurance de ma très haute considération.

Le Président,
Roger B. Hamel

pièce jointe

LA CHAMBRE DE COMMERCE DU CANADA
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CABINET DU PRESIDENT

le 13 août 1985

L'hon. Thomas Siddon, C.P., député
Ministre d'Etat chargé des Sciences
et de la Technologie
Pièce 119, Edifice de l'Est
Chambre des communes
Ottawa, Ontario K1A 0A6

Monsieur le Ministre,

Suite à notre rencontre du 13 mai, le comité de R-D de la Chambre profite de cette occasion pour vous transmettre ses commentaires sur la recherche universitaire financée par le biais du Conseil de recherches en sciences naturelles et en génie.

Pour pouvoir être concurrentiel et prospérer dans un monde hautement technologique et très compétitif, le Canada a besoin d'une forte capacité d'innovation et d'être assuré en tout temps d'une main-d'oeuvre d'excellente qualité. Il ne pourra y parvenir qu'en garantissant que ses universités sont capables de recherche et de développement de qualité. Ceci est crucial si les attentes en main-d'oeuvre et en R-D du gouvernement, de l'industrie et de la société en général doivent être satisfaites. Tout ce qui peut encourager, développer et rehausser les possibilités de nos universités est essentiel si l'on veut garantir l'avenir de notre pays et de nos descendants.

Le monde des affaires s'inquiète de plus en plus que les pressions exercées sur le financement des universités puissent éventuellement interdire à ces dernières de répondre efficacement aux demandes de la société. L'absence de fonds ne leur permet pas de remplacer le corps enseignant âgé et le matériel désuet. Ce remplacement sera un prérequis pour la formation des étudiants et des scientifiques au cours des cinq à quinze prochaines années.

Les universités trouvent de plus en plus difficile et même parfois impossible de satisfaire les demandes de R-D qui leur sont faites à cause du manque d'espace, des installations désuètes et du corps professoral et du personnel de soutien insuffisants. Les inscriptions sont plus nombreuses et, en termes réels, le financement par étudiant a diminué d'au moins vingt pourcent ou plus au cours de la dernière décennie dans nombre de provinces.

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La Chambre reconnaît que le gouvernement fait face à de sérieuses contraintes budgétaires et elle est entièrement d'accord avec les efforts de réduction des dépenses afin d'améliorer le déficit et la dette de notre pays. Néanmoins, nous croyons qu'à l'intérieur des limites imposées par les contraintes budgétaires actuelles, le financement des universités devrait être considéré comme domaine prioritaire. Nous recommandons plus précisément:

- Que ces problèmes soient résolus par des négociations fédérales-provinciales sur le financement de l'éducation postsecondaire en veillant à ce que les universités aient le soutien voulu pour leurs activités de recherce si elles doivent répondre aux besoins du gouvernement, de l'industrie et de la société en recherche et en main-d'oeuvre hautement qualifiée.

- Que le secteur privé, les syndicats et les universités soient engagés de façon permanente dans les négociations concernant le financement des universités et les objectifs technologiques et scientifiques du pays. La planification devrait se faire à long terme et les modifications soudaines devraient être évitées.

- Que le besoin de qualité dans l'enseignement et dans la recherche soit complètement respecté au cours des négociations, même avec les présentes contraintes financières auxquelles les gouvernements font face.

- Afin de maintenir le nombre de scientifiques et d'ingénieurs requis pour atteindre les objectifs de R-D, que la formation des étudiants du deuxième et du troisième cycles universitaires soient renforcée par l'octroi d'un soutien approprié en matériel et en installations.

- Que des stimulants spéciaux soient envisagés pour attirer les étudiants les plus doués vers les plus hauts niveaux de leur profession. L'identification et le soutien du potentiel de leadership et de gestion sont particulièrement importants.

- Que les étudiants étrangers, surtout à partir du deuxième cycle, ne soient pas découragés de venir s'instruire au Canada à cause, par exemple, de frais d'inscription plus élevés.

- Que les programmes de transferts de technologie entre universités et industries soient encouragés.

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Le secteur privé est conscient des contraintes financières et des sacrifices qu'il faut faire. La Chambre est toutefois convaincue que l'avancement de la recherche scientifique et le développement doivent être soutenus au plus haut niveau dans nos universités. Les économies apparentes à court terme qui pourraient découler du sous-financement actuel seraient entièrement effacées par la tragédie qui, quasi inévitablement, en résulterait.

Je vous prie d'agréer, Monsieur le Ministre, l'assurance de ma haute considération.

Roger Hamel

c.c.: l'hon. Walter McLean, secrétaire d'Etat
l'hon. Sinclair Stevens, ministre de l'Expansion industrielle régionale
l'hon. Michael Wilson, ministre des Finances
les ministres provinciaux de l'Education

LA CHAMBRE DE COMMERCE DU CANADA
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CABINET DU PRESIDENT

le 13 août 1985

L'hon. Thomas Siddon, C.P., député
Ministre d'Etat chargé des Sciences et
de la Technologie
Pièce 119, Edifice de l'Est
Chambre des communes
Ottawa, Ontario K1A 0A6

Monsieur le Ministre,

Suite à notre rencontre du 13 mai, le comité de R-D de la Chambre est heureux de pouvoir commenter les pratiques des marchés scientifiques du ministère des Approvisionnements et Services.

Ses principales recommandations peuvent se résumer comme suit:

1. Le ministère des Approvisionnements et Services devrait conserver sa responsabilité actuelle des marchés scientifiques afin de garantir une meilleure uniformité. Cependant, les règlements concernant ces marchés devraient être révisés pour tenir compte de leur nature particulière.

2. Les procédures internes relatives à l'émission de contrats devraient être révisées et simplifiées afin de réduire le temps requis par le ministère pour émettre les contrats.

3. La technologie, les brevets, les droits d'auteur et les nouveaux produits développés par le secteur privé avec l'aide du gouvernement devraient rester la propriété de l'entreprise qui y a participé et non celle du gouvernement.

4. Pour aider les PME à soumissionner et à négocier des contrats, il faudrait créer un bureau indépendant du protecteur du citoyen.

5. Afin de résoudre le problème des dates limites fixes pour recevoir les soumissions, les bureaux régionaux du ministère devraient pouvoir apposer la date de réception des soumissions au nom du bureau d'Ottawa.

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Nous élaborerons maintenant les points susmentionnés ainsi que d'autres sujets que le comité juge importants.

Rôle du MAS dans les marchés scientifiques

Les procédures en vigueur au MAS ont créé des difficultés pour nos membres parce qu'elles ne tiennent pas assez compte de la nature particulière des marchés de R-D qui diffèrent des autres en biens et en services courants.

Nous pensons que des mesures devraient être prises pour améliorer le système actuellement en vigueur. Nous suggérons que la Direction générale des sciences et des services professionnels du MAS soit autorisée à exempter les contrats scientifiques des conditions qui n'ont rien à voir avec les marchés scientifiques. Il faut poursuivre les efforts en vue d'aboutir à une réglementation spéciale pour ce genre de marché. De plus, le directeur général devrait avoir l'autorité discrétionnaire d'interpréter les règlements en vigueur.

Nous sommes fermement convaincus que le MAS doit demeurer responsable des marchés scientifiques afin que le système des marchés demeure le plus uniforme possible.

La création d'un système des marchés totalement nouveau, avec la responsabilité transférée à d'autres ministères, entraînerait toutes sortes de problèmes prévisibles et imprévisibles. Nous notons que déjà plusieurs ministères et agences sont responsables de leurs propres marchés -- comme le Conseil national de recherches, l'Agence canadienne de développement international, le ministère de la Santé et du Bien-Etre ainsi que celui de la Consommation et des Corporations. D'après nos membres, ces marchés directs ne donnent pas de meilleurs résultats. Dans certains cas, les négociations prennent beaucoup plus de temps qu'avec le MAS. La voie offerte par ce dernier a tendance à offrir un bien meilleur accès aux soumissionnaires éventuels.

Les ministères et les agences qui s'approvisionnent eux-mêmes et suivent leurs propres règlements constituent un autre sujet de préoccupation, car cela peut engendrer une certaine confusion pour les affaires et créer des obstacles pour les soumissionaires. Nous recommandons donc que les ministères et les agences utilisent les mêmes procédures et les mêmes pratiques que le MAS losqu'ils s'approvisionnent eux-mêmes.

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Procédures concernant les marchés scientifiques

Ce qui préoccupe le plus les affaires, c'est la durée qu'il faut au MAS pour émettre un contrat. Selon notre expérience, les ministères contractants étudient assez rapidement le contenu scientifique des propositions. Toutefois, le processus du MAS pour les traduire en termes contractuels est beaucoup plus long qu'il le faut, surtout lorsqu'on sait que la majeure partie du libellé des contrats est normalisée.

Nous recommandons que les diverses étapes internes par lesquelles tout contrat doit passer au MAS soient révisées et normalisées. L'objectif serait que le contrat soit établi en une ou deux semaines lorsqu'un libellé normalisé est utilisé et lorsqu'une déclaration de travail approuvée par le ministère et l'entreprise est fournie. En ce moment, ce genre de situation demande un délai de vingt semaines, surtout s'il s'agit de gros contrats. Même dans certains cas, il faut un an pour passer au travers de cette procédure. Nous suggérons au ministère d'envisager: (a) d'imposer une durée précise pour la préparation des contrats et (b) d'établir des procédures pour surveiller le temps qu'il faut pour étudier les propositions en vue de s'assurer que l'on respecte le temps accordé.

Droit à la propriété intellectuelle

Le gouvernement s'adjuge le droit de propriété intellectuelle dans tout contrat de recherche auquel le MAS participe avec le secteur privé sur une base de coûts partagés. Nous notons que ce genre d'innovations se fait en général à partir d'une expertise déjà bien établie dans l'industrie, la participation financière du gouvernement ne couvrant que partiellement les coûts réels de développement.

Nous sommes fermement convaincus que les technologies, les brevets, les droits d'auteur et les nouveaux produits développés par le secteur privé avec l'aide du gouvernement soit par subside, soit par contrat, devraient revenir à l'entreprise participante.

Une telle attitude ferait beaucoup pour le développement de technologies dont tous les Canadiens profiteraient.

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Politique de "fabriquer ou acheter"

La politique de "fabriquer ou acheter" que la Chambre avait accueillie avec enthousiasme fut introduite il y a environ dix ans. Nous sommes toutefois déçus que les ministères aient été si lents à l'adopter. Comme indication, il suffit de noter que le pourcentage des activités de R-D menées sous contrat n'a pas augmenté depuis quelques années.

Nous notons que les fonctionnaires responsables de la prestation de programmes de R-D ne semblent pas vouloir les sous-traiter. Ceci provient en partie du fait que les règlements penchent en faveur des activités internes de R-D. Par exemple, la comparaison entre les coûts internes et les coûts externes n'est généralement pas très réaliste, les coûts internes étant habituellement sous-estimés. Cette comparaison sert toutefois à justifier l'activité interne. Dans d'autres cas, les scientifiques du gouvernement ne désirent pas soutenir un projet extérieur du fait du surcroît de travail administratif que cela leur impose. Certains voient ces projets comme étant en compétition avec les leurs. Les employés du gouvernement ne sont donc pas encouragés à sous-traiter.

Nous recommandons que la politique de "fabriquer ou acheter" soit révisée et que des mécanismes soient introduits afin de faciliter la recherche sous contrat dans le secteur privé. Un moyen pour ce faire serait de fixer un quota précis pour les recherches internes et pour celles faites à l'extérieur. Ce quota devrait correspondre à ceux des autres pays.

Propositions spontanées

La Chambre est en général très en faveur des propositions spontanées qui découlent des politique de "fabriquer ou acheter". Elle pense cependant que ce programme pourrait être amélioré afin qu'il soutienne encore mieux les activités de R-D du secteur privé.

Une exigence clé pour qu'une proposition soit acceptée, c'est que la technologie suggérée soit utile au ministère client. Cependant, il arrive que la proposition ait une valeur certaine pour l'entreprise du secteur privé même si

Il arrive souvent que le soumissionnaire ne reçoive l'appel d'offre que quelques jours avant la date de soumission. Il ne lui reste alors que peu de temps pour préparer sa soumission et voir à ce que le MAS la reçoive en temps. Nous pensons que plusieurs mesures pourraient être prises pour faciliter les procédures.

Le MAS a un réseau de bureaux régionaux à la grandeur du Canada. Nous recommandons que ces derniers, en plus d'enregistrer la date des contrats qu'ils émettent, puissent fournir le même service au nom du bureau d'Ottawa. En exigeant que la soumission soit remise directement à Ottawa, le ministère impose aux soumissionnaires régionaux un désavantage concurrentiel marqué.

Quand les soumissions sont livrées par messagerie à Ottawa, le messager ne peut accéder au bureau des soumissions du MAS. Le soumissionnaire perd de ce fait plusieurs jours pendant lesquels sa soumission voyage de la réception au bureau des soumissions. Nous recommandons donc que les messagers puissent avoir accès au bureau des soumissions.

Processus de pré-admissibilité

Nous félicitons le ministère pour avoir mis en place les présentes procédures de pré-admissibilité et de les avoir observées, car elles simplifient et accélèrent le processus des soumissions. A notre avis, une utilisation plus étendue de ces procédures encouragerait le développement des capacités technologiques du secteur privé.

Concurrence entre les organisations du secteur public et les universités

A notre avis, le MAS devrait faire tout ce qu'il peut pour ne pas accepter de soumissions du secteur public lorsque le secteur privé est capable d'y répondre. Nous suggérons que cette politique soit examinée régulièrement pour s'assurer qu'elle est respectée dans toute la mesure du possible.

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Nous espérons que les vues exprimées ci-dessus vous seront utiles. Nous sommes prêts à élaborer davantage les points que vous-même ou vos fonctionnaires pourraient soulever.

Je vous prie d'agréer, Monsieur le Ministre, l'assurance de ma haute considération.

Roger Hamel

c.c.: L'hon. Harvie André, ministre
Ministère des Approvisionnements et Services

L'hon. Robert de Cotret, président
Conseil du Trésor

LA CHAMBRE DE COMMERCE DU CANADA
200 RUE ELGIN • BUREAU 301 • OTTAWA, ONTARIO K2P 2J7 • (613) 238-4000

CABINET DU PRÉSIDENT

le 10 octobre 1984

L'hon. Thomas Siddon, conseiller privé,
député
Ministre des Sciences et de
la Technologie
Pièce 119, Edifice de l'Est
Chambre des communes
Ottawa, Ontario K1A 0A6

Monsieur le Ministre,

Le comité de la Chambre de Commerce du Canada de la Recherche et du Développement a suivi avec beaucoup d'intérêt les travaux du groupe d'étude des politiques et programmes fédéraux relatifs au développement technologique. Ce comité de la Chambre a déjà fait plusieurs présentations à ce groupe et est heureux de pouvoir commenter le rapport que ce dernier vient de publier.

Le rapport recommande une participation accrue du secteur privé aux activités de R & D du gouvernement et une plus grande confiance dans les forces du marché pour orienter la R & D au Canada. Nous sommes également en faveur de cette approche puisque nous croyons qu'une plus grande confiance dans les forces du marché entraînerait une meilleure utilisation des ressources humaines et financières consacrées à la R & D. Nos commentaires sur les propositions spécifiques du rapport peuvent se résumer comme suit:

Participation accrue du secteur privé à la R & D du gouvernement

Le rapport suggère que le secteur privé participe davantage aux activités de R & D qui ont lieu dans les laboratoires du gouvernement. Nous pensons qu'une telle participation comblerait le fossé découlant de l'absence de communication entre les milieux de R & D du gouvernement et ceux du secteur privé. Il en résulterait une R & D mieux orientée vers les besoins industriels

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présents et futurs du Canada. Du point de vue de l'efficacité et de la pertinence, la participation du secteur privé devrait être accrue dans la planification des nouvelles activités de R & D du gouvernement.

Des représentants du secteur privé devraient être nommés aux conseils d'administration des divers laboratoires fédéraux dont, par surcroît, le mandat devrait être révisé périodiquement par des groupes de pairs spécialement créés à cette fin. Nous sommes fermement convaincus que pour être efficaces, les membres des conseils d'administration et des groupes de pairs doivent avoir l'expertise voulue et ne devraient donc être choisis qu'en fonction de leur mérite. De plus, leur nomination ne devrait être faite qu'après consultation des associations d'affaires ou de professionnels, ou les deux, ainsi que des syndicats. La Chambre serait heureuse de suggérer des noms de personnes du secteur privé, engagées dans la recherche.

Contrats de R & D passés à l'extérieur

Le rapport recommande que la R & D faite à l'intérieur soit restreinte au cas où la "nécessité de confidentialité ou de neutralité s'impose, ou lorsque le contrat passé à l'extérieur n'est pas rentable à long terme". Nous sommes ravis de cette attitude et nous pensons qu'un plus grand nombre d'activités internes devraient être exécutées sous contrat à l'extérieur.

L'une des approches permettant d'obtenir l'exécution à l'extérieur, sous contrat, pourrait être le programme des propositions spontanées que le ministère des Approvisionnements et Services administre. Ce programme est un bon exemple d'utilisation du secteur privé pour donner une certaine orientation aux dépenses publiques en R & D.

Étude des laboratoires du gouvernement

Nous pensons qu'une étude indépendante et détaillée des mandats des laboratoires du gouvernement devrait être faite. L'organisme chargé de cette étude devrait être tenu de faire des recommandations lorsqu'il constate que les mandats ne correspondent plus aux besoins actuels, afin qu'ils soient modifiés ou que le laboratoire en question soit éliminé.

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Confiance accrue dans les forces du marché pour orienter la R & D

La Chambre est d'accord avec le groupe d'étude pour utiliser le système fiscal en vue d'encourager la R & D, le marché pourrait ainsi choisir des projets de R & D adéquats, ce qui entraînerait également la production de produits et procédés rentables.

Programmes gouvernementaux d'aide à l'industrie

Le rapport suggère qu'un grand nombre des programmes d'aide en vigueur devraient être abandonnés ou sérieusement modifiés. A notre avis, beaucoup de programmes ont cessé d'être utiles, et nous sommes donc entièrement d'accord avec cette recommandation. Nous sommes convaincus qu'il serait utile, d'en faire une analyse de rentabilité pour s'assurer qu'ils répondent encore bien aux besoins actuels. A cet effet, nous avons noté que les récentes modifications apportées à la Loi de l'impôt sur le revenu offrent de nouvelles possibilités aux entreprises, y compris les PME, pour financer leurs activités de R & D. D'une façon générale, nous préférons cette approche puisqu'elle s'appuie sur les forces du marché plutôt que sur des décisions bureaucratiques.

Achats par le gouvernement de produits de haute technologie

Nous sommes d'accord avec la remarque du rapport signalant que les ministères du gouvernement ne manifestent guère d'intérêt dans l'achat de produits nouvellement développés au Canada. Leur achat chez des fournisseurs canadiens devrait être encouragé lorsque leur prix est concurrentiel. Nous pensons que ceci devrait s'appliquer particulièrement aux ministères ou aux agences du gouvernement, ou aux deux, ayant une expertise technologique bien établie (et lorsque le montant investi avec risques est raisonnable).

Aide à la R & D universitaire

Nous apprécions l'idée suggérée par le groupe d'étude qui vise à étendre les crédits fiscaux de R & D aux universités lorsque celles-ci viennent en aide à l'industrie. Une telle attitude entraînerait de meilleurs échanges d'informations entre les universités et l'industrie car en ce moment, les liens unissant ces deux secteurs sont plutôt faibles. Il n'existe qu'un seul mécanisme officiel pour le transfert de technologie entre les universités et l'industrie, le programme PCLI

du Conseil national de recherches. Mais lui aussi présente des problèmes, car il est compliqué et il est administré par des personnes n'ayant pas assez de connaissances et d'expérience du marché.

Nous sommes également d'accord avec la recommandation visant à accroître le financement de R & D accordé aux universités. Nous pensons qu'il jouera un rôle de plus en plus grand dans ce domaine, et le gouvernement devrait en tenir compte dans son propre financement de R & D. L'objectif devrait être une augmentation générale de la part accordée aux universités dans le financement des R & D. Toute augmentation des dépenses fédérales dans ce domaine ne doit pas, par conséquent, s'accompagner de réductions équivalentes dans celles des provinces.

Nous notons qu'une partie du financement devrait être consacrée à la promotion et à la création de "centres d'expertise" afin de concentrer les activités de R & D et éviter les répétitions coûteuses.

Définition de la R & D

Nous appuyons la suggestion du groupe d'étude visant à élargir la définition de la R & D, aux fins de l'impôt, afin de la rendre plus compatible avec celle utilisée aux États-Unis, éliminant ainsi effectivement la règle "d'entièrement attribuable" du Canada. Il faut admettre que les PME n'ont pas les moyens d'utiliser du personnel à plein temps pour leur R & D. Cette dernière se fait bien souvent à temps partiel grâce aux installations existantes. Notre système fiscal devrait en tenir compte.

Transfert du IRDP au Conseil national de recherches

Le CNRC est, par tradition, engagé dans la recherche fondamentale. Nous pensons que c'est son rôle et mettons en doute la justification de la recommandation du transfert du MEIR au CNR des éléments du PDIR voués au développement technologique. A l'encontre du ministère de l'Expansion industrielle régionale, le CNRC n'a guère de personnel ayant une expérience dans la recherche industrielle. Nous sommes donc en faveur du statu quo dans ce domaine.

.../5

Rôle du conseiller scientifique en chef

Nous jugeons ce poste important et pensons qu'il devrait être maintenu. Pour qu'il soit efficace, nous suggérons que le conseiller essaye d'obtenir la participation maximale d'un large éventail des communautés industrielles et universitaires, en plus des vues des divers ministères. Il devrait être accessible à toute personne extérieure au gouvernement.

Nous serions heureux d'explorer plus à fond les idées développées dans cette lettre avec vous et avec vos hauts fonctionnaires. En fait, une petite délégation de notre comité serait heureuse de pouvoir vous rencontrer à Ottawa dès que vous le pourrez.

Je vous prie d'agréer, monsieur le Ministre, les assurances de ma très haute considération.

Samuel F. Hughes

SFH/gsp

DOCUMENT: 830-220/014

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Towards a Science and Technology Policy for Canada

The Canadian Chemical Producers' Association

June 8-10, 1986
Winnipeg, Manitoba

The
Canadian
Chemical
Producers'
Association

Suite 805
350 Sparks Street
Ottawa K1R 7S8

Telephone
(613) 237-6215

May 23, 1986

Mr. John Gundy
Ministry of State for
Science and Technology
C.D. Howe Building
Ottawa, Ontario

Dear Mr. Gundy:

Winnipeg Forum

With reference to Mr. Oberle's letter of April 30 to Mr. Jean Belanger, president of this association, I enclose a discussion paper outlining our views on a number of key issues. It would be appreciated if you would make the paper available to Forum participants.

As I believe you have been informed previously, Mr. G.B. Dyer will represent the association at the meeting in his capacity as Chairman of the CCPA Research and Development Committee. Mr. Dyer's address is:

Mr. G.B. Dyer
Manager, Research Division
Du Pont Canada Inc.
P.O. Box 5000
Kingston, Ontario
K7L 5A5
Telephone: (613) 544-6400, ext. 2376

Yours sincerely,

G.C. Gibb
Director, Economic Affairs

GCG/mh

Attachment

TOWARDS A SCIENCE AND TECHNOLOGY POLICY FOR CANADA

A Discussion Paper

presented to the

Canadian Forum on a National Science and Technology Policy

on behalf of

The Canadian Chemical Producers' Association

by

G.B. Dyer, Chairman

CCPA R&D Committee

Winnipeg, Manitoba
June 8, 1986

TOWARD A NATIONAL SCIENCE AND TECHNOLOGY POLICY FOR CANADA

Introduction

The Canadian Chemical Producers' Association welcomes the opportunity to participate in discussions leading to the development of a national science and technology policy for Canada. The intention in this paper is to highlight a number of key concepts which it is believed are fundamental, and we expect to elaborate in greater depth and detail as the policy development activity evolves over coming months.

The Association represents some 70 manufacturing companies which produce about 90% of Canada's total output of manufactured chemicals. With annual production in the order of $8.5 billion, the industry directly employs more than 28,000 people, of whom approximately 18% are university graduates and a further 13% technicians. Thus the industry is a technology intensive one with a strong involvement in industrial research and development. It purchases from a very broad range of resource industries, equipment suppliers and others, and virtually all of its output flows into other manufacturing processes at home or abroad before reaching final consumers. Thus the industry is extremely sensitive to its own international competitive position and those of the industries it serves.

Policy Objective

The CCPA believes that the primary purpose of a national science & technology policy should be to improve the competitive strength of Canadian businesses. Specifically, such a policy should aim to ensure that Canadian enterprises have available to them, and are free to use, the most up-to-date technology extant. **In other words, the policy has to focus on providing support to companies to acquire, develop and use technology as an integral part of their business strategy.**

Acquiring Technology - Make or Buy

Canadian companies will be able to develop only a part of the technology essential to the achievement of competitive goals. **Canadian science & technology policy, therefore, must address a mix of buy and make goals.** (Also, as our technology development activity grows, we will have to recognize sale of technology to other countries as a small but important part of science & technology policy.)

Almost all technology evolves with time; technology that is not evolving is becoming obsolescent. If enterprises are to be dynamic and competitive the real choices are:

1) to develop (make) one's own technology and build on it to provide for the necessary improvements to maintain competitiveness;

2) to buy technology and develop an in-house capability to provide for the necessary improvement to maintain or even gain in competitiveness (a policy followed well in Japan);

3) to buy technology and then buy improvements as required.

Technology is seldom uniquely developed and a mixture of (1) and (2) is common and often desirable.

Purchased technology will always be very important to Canadian businesses. **National science & technology policy therefore must place no artificial impediments on its acquisition, use, and dissemination.**

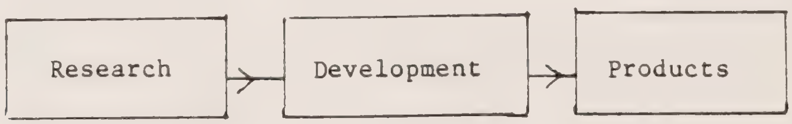
Nevertheless, Canadian science & technology policy obviously cannot rely on the purchase option alone. Technology available for purchase is more likely to be for maturing products and processes. Canadian businesses will need to develop their own technologies and to build on purchased technologies. Both of these are considered to be encompassed in the "make" option.

Science and Technology Models

A useful approach to the development of science and technology policies is the examination of research and development models.

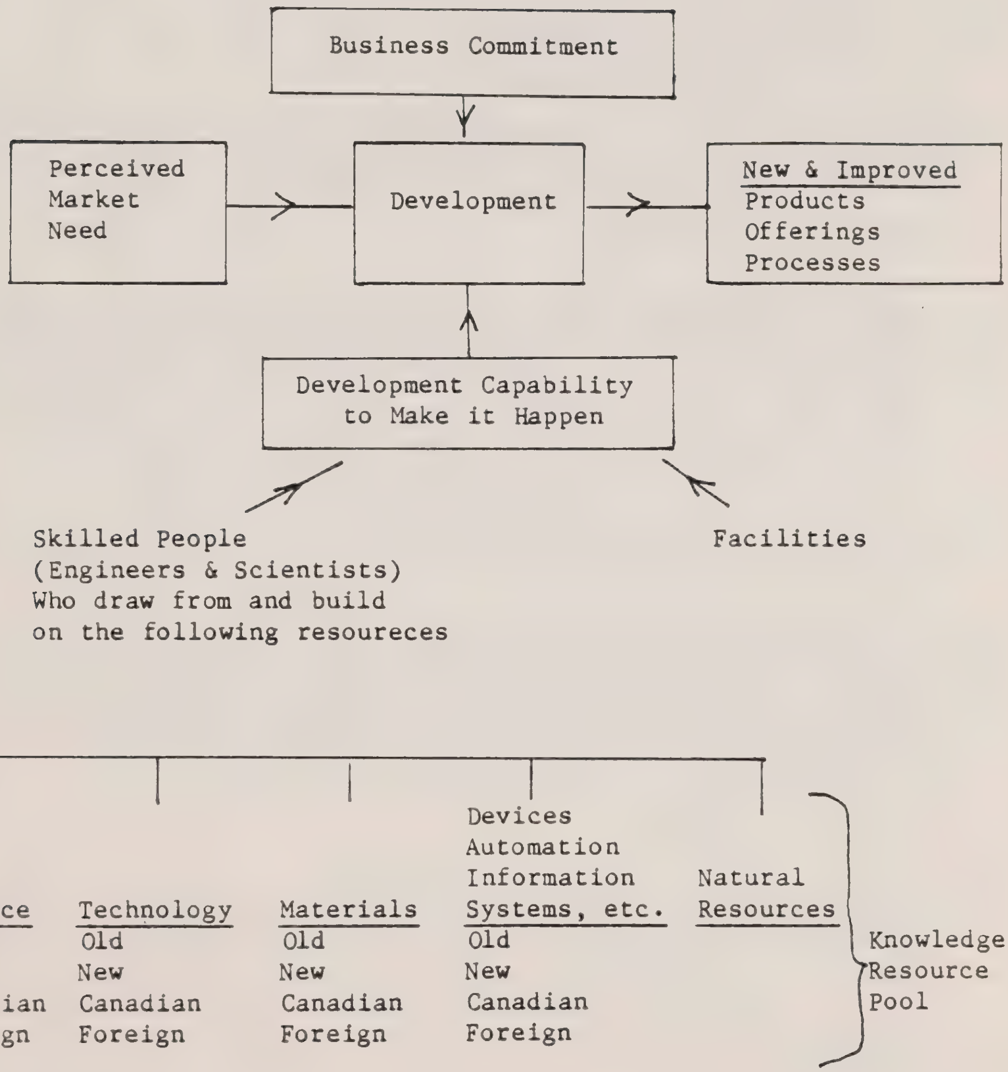
a) A Common Contemporary Model

A common model used to relate research and development presents a research push picture.



It is now generally accepted that it is much more useful to consider technology with a market focus in mind.

b) The Market Focussed Model



Elements of Technology Development

The market focussed model, while perhaps overly simplistic, clearly shows the main components of the successful development of new and improved technology, viz:

Perceived Market Need
Business Commitment
Skilled Development People
Development Facilities
Knowledge Resource Pool

An effective science & technology policy needs to address ways of enhancing each of these five basic parameters.

1) Perceived Market Need

Both the specific need and its potential market size are important. Canadian government policy should consistently be directed to opening up additional market opportunities to technology-based goods manufactured in Canada. Tariff and non-tariff trade barriers are key issues and Canadian business needs to look at foreign markets with even greater attention, especially in evaluating the opportunities arising from development activities.

Government procurement policies can have a very positive influence on market opportunities.

Businesses (including entrepreneurs) are the best vehicle for identifying perceived market needs and for making the commitment to follow through. **Industrial technology development should be done in industry, and not in government laboratories with the idea of transferring it to industry.**

2) Business Commitment

Expenditure on Research and Development is inherently "risky" because of the uncertainty of success. Business and enterpreneurs will only make the commitment to acquiring or developing technology if they have a reasonable probability of earning a satisfactory return. **Therefore, a stable and healthy economic climate is the single most important factor in influencing investment in technology.**

It is also essential that government actions provide a positive environment for undertaking a business commitment. **Canada must have competitive policies on energy, intellectual property rights, taxation and general regulation of companies.**

Canada has a mix of tax incentives and grants which encourage or assist R&D activities in businesses. **A key issue is that the nature and level of support be comparable to those provided in competing countries.** The "risk" of development for companies is related to both the cost of R&D and the time before significant sales revenue will occur. This is a particular problem with major developments in some of the new technology areas, such as biotechnology, ceramics, and advanced composites. The "risk overhang" can be of literally "bet the company" proportions. In many countries fully funded developments in advanced technologies for military purposes have direct commercial spin-offs of great value. Canada's science & technology policy should recognize the different priority accorded defense in this country and provide equivalent risk sharing to be able to compete in the spin-off areas (e.g. advanced materials).

Our business, science and engineering schools need to ensure that an understanding of the value and importance of technology development is introduced into the undegraduate curricula.

3) Skilled Development People

Skilled development people will be key to a successful Canadian science & technology policy. We must ensure an adequate supply of well trained people. NSERC has addressed the potential shortage and its importance in its planning documents.

University research plays an essential role in providing the basis and environment for educating the people who will fit into the industrial development activity, and who will carry with them into this activity, not only a sound understanding of scientific investigation, but also a sound ability in acquiring and building on existing knowledge. The equally important role of educating the next generation of "teachers" must be recognized.

It will be necessary to increase funding to support university research and research facilities. We encourage the development of relatively few centres of excellence so that the available funds can be most effectively used.

The Ph.D. program has tended to become longer in Canadian universities. A shortened Ph.D. program (returning to the 3 year goal from bachelors degree) is recommended because of the potential to increase the number of people receiving this training at any one time, and to make it more attractive for our best young graduates to pursue.

4) Development Facilities

Development facilities should normally be located in the corporation undertaking the work. They need to be of high quality and take advantage of the latest technology.

There are some situations where shared facilities offer a definite advantage:

- unique national facilities (e.g. wind tunnel);
- contract development facilities which offer both facilities and people skills and are of particular value to smaller companies (e.g. ORF);
- university/industry shared facilities (e.g. specialized analytical equipment).

Modern developments lead quickly to the need to supply commercial product. It is frequently appropriate to make initial commercial product offerings from pilot facilities. **Science & technology policy should ensure that this type of development is encouraged and the R&D incentives related to facilities are not inappropriately penalized.**

5) The Knowledge Resource Pool

As already noted, most of the knowledge resource pool will be international and Canada will only be a minor contributor to the pool. Canadians will want to be able to have access to all of it, and the most important consideration is that our development people have this ability. **Our science & technology policies must encourage the broadest access and utilization in pursuing Canadian developments.** We encourage ongoing improvements in knowledge access systems.

Canadian science activity will always be small relative to the world total. In this situation, we should focus our relatively limited efforts on the support of Canadian industrial competitiveness. In addition to the educational aspect, the other role of university research is to develop new scientific understanding based on well-conducted investigations. **Improved university/industry relationships should be encouraged as the best way of making university research more relevant to industry.** The appropriate role for university research is probing scientific investigation; industrial research should carry out the development and commercialization. We are concerned that too great a focus on "making universities relevant" might lead to short term development activities to the detriment of both research and education.

The knowledge resource pool goes well beyond new discoveries in science. In fact, the "new science" element of new industrial developments can vary from being of crucial importance to being virtually insignificant. Technology developments such as the computer and new materials can have profound implications in developing improved processes and products. **Our science and technology policy needs to recognize the breadth and importance of the total knowledge resource pool.**

Related Issues

1) Government R&D

Government R&D may be appropriate in certain fragmented industries such as agriculture, but it is not an appropriate strategy for industry generally. The CCPA supports the Canadian Manufacturers' Association (CMA) recommendation that in developing a national science & technology policy, federal and provincial governments should establish the principle that government should not generally do industrial technology development for the purpose of transferring it to industry.

2) Technology Centres

The Canadian Chemical Producers' Association supports fully the recommendations on technology centres made by the Canadian Manufacturers' Association in its paper "Improving our Industrial Competitiveness". In particular proposals for new centres should be initiated by the private sector clients they will serve. This would ensure that centres are established on the basis of identified industry needs, not on unilateral government views of what those needs are. The result would be more effective technology centres at lower cost to government.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Élément d'une politique scientifique et technologique pour le Canada

L'Association canadienne des fabricants de produits chimiques

du 8 au 10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

ÉLÉMENTS D'UNE POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE POUR LE CANADA

Introduction

L'Association canadienne des fabricants de produits chimiques se réjouit de pouvoir participer aux discussions qui aboutiront à l'élaboration d'une politique scientifique et technologique nationale pour le Canada. Le présent document de discussion a pour but de mettre en évidence un certain nombre de concepts clés qui apparaissent comme fondamentaux et que nous entendons approfondir au cours des prochaines mois à mesure que la politique prendra forme.

L'Association représente quelque 70 entreprises manufacturières qui produisent environ 90 % de l'ensemble des produits chimiques du Canada. L'industrie, dont la production annuelle est de l'ordre de 8,5 milliards de dollars, emploie directement plus de 28 000 personnes, dont environ 18 % sont des diplômés universitaires et 13 % des techniciens. Il s'agit donc d'une industrie à forte concentration technologique qui participe activement à la recherche et au développement industriels. Elle s'approvisionne auprès d'un très grand nombre d'industries extractives, de fournisseurs d'équipement et d'autres entreprises. De plus, pratiquement toute sa production est utilisée dans d'autres procédés de fabrication, au Canada ou à l'étranger avant d'atteindre le consommateur. C'est pourquoi notre industrie accorde une extrême importance à sa propre compétitivité sur les marchés internationaux et à celle des industries qu'elle dessert.

Objectif de la politique

L'ACFPC est d'avis qu'une politique scientifique et technologique nationale devrait avoir pour premier objectif de renforcer la compétitivité des entreprises canadiennes. Plus précisément, cette politique devrait viser à mettre à la disposition des entreprises canadiennes la technologie la plus moderne. **Autrement dit, la politique doit faire une place importante au soutien qui permettra aux entreprises d'acquérir, de développer et d'utiliser la technologie de manière à l'intégrer véritablement à leurs stratégies commerciales.**

Acquisition de la technologie - fabriquer ou acheter

Les compagnies canadiennes ne seront capables de développer qu'une partie de la technologie essentielle à la réalisation de leurs objectifs. **Une politique scientifique et technologique canadienne doit par conséquent se pencher sur des objectifs qui combinent fabrication et d'achat.** (En outre, à mesure que le développement technologique prendra de l'expansion, la politique scientifique et technologique devra prévoir une place pour l'exportation des technologies, même si cet aspect a une importance limitée.)

Toute technologie, ou presque, évolue avec le temps, à défaut de quoi elle devient désuète. Par conséquent, soient pour être dynamiques et concurentielles, les entreprises diposent des choix réels suivants :

1) mettre au point (fabriquer) leur propre technologie et y apporter les perfectionnements nécessaires au maintien de leur compétitivité;

2) acheter la technologie et se doter de la structure qui leur permette de réaliser les perfectionnements nécessaires au maintien ou à l'amélioration de leur compétitivité (c'est une politique qui réussit très bien au Japon);

3) acheter la technologie et, ensuite, acheter également les perfectionnements nécessaires.

La technologie se développe rarement en circuit fermé; c'est pourquoi il est souvent souhaitable d'opter pour une combinaison du premier et du deuxième choix.

Etant donné que l'achat de technologies sera toujours très important pour les entreprises canadiennes, **une politique scientifique et technologique nationale ne devra pas poser d'obstacles artificiels à l'acquisition, à l'utilisation et à la diffusion de la technologie.**

Malgré tout, il est clair qu'une politique scientifique et technologique canadienne ne peut reposer exclusivement sur l'achat de technologie. En effet, la technologie que l'on peut acheter convient le plus souvent aux produits et aux procédés déjà bien implantés. Or, les entreprises canadiennes auront besoin de développer leurs propres technologies et de travailler à partir des technologies qu'ils auront acheter. Ce sont ces deux aspects qui sont regroupés dans l'option "fabrication".

Deux modèles

Il est utile, quand on élabore des politiques scientifiques et technologiques, d'examiner les modèles de recherche et de développement.

a) Modèle contemporain courant

Il existe un modèle courant dans lequel la recherche joue le rôle moteur.

Recherche	—	Développement	—	Produits

Mais il est maintenant généralement admis qu'il est beaucoup plus utile d'aborder l'aspect technologique en fonction d'un marché cible donné.

b) <u>Modèle orienté vers le marché</u>

Engagement de l'entreprise

Anticipation des besoin du marché

Développement

<u>Nouveautés et améliorations</u>
Produits
Procédés

Structure de développement
pour réaliser la stratégie

Personnel qualifié
(ingénieurs et chercheurs)
qui utilisent les
ressources suivantes

Installations

<u>Science</u>

<u>Technologie</u>

<u>Matériaux</u>

<u>Appareils Automatisation Systèmes informatiques, etc.</u>

<u>Ressources naturelles</u>

Sources de Connaissances

Éléments du développement technologique

Le modèle orienté vers le marché, s'il est un peu simpliste, fait néanmoins ressortir clairement les principaux éléments qui permettent de développer et d'améliorer efficacement les technologies, à savoir :

Anticipation des besoins du marché
Engagement de l'entreprise
Personnel qualifié affecté au développement
Installations de développement
Sources de connaissances

Une politique scientifique et technologique efficace doit chercher les moyens de renforcer chacun de ces cinq paramètres de base.

1) Anticipation des besoins du marché

Il faut tenir compte à cet égard des besoins particuliers que l'on anticipe et de l'importance du marché potentiel. La politique du gouvernement canadien devrait toujours être orientée vers la création de nouveaux marchés pour les produits à base de technologie fabriqués au Canada. Les barrières commerciales tarifaires et non tarifaires sont en effet des éléments clés qui exigent des entreprises canadiennes encore plus d'attention quand elles abordent les marchés étrangers, particulièrement quand elles évaluent les débouchés créés par les activités de développement.

Les politiques d'approvisionnement du gouvernement peuvent avoir un effet très favorable sur les débouchés commerciaux.

Ce sont les entreprises et les entrepreneurs qui sont les mieux placés pour prévoir les besoins du marché et pour prendre les engagements qui s'imposent. Le **développement technologique industriel devrait être réalisé dans l'industrie et non dans les laboratoires du gouvernement dans le but d'en transférer ensuite les résultats à l'industrie.**

2) Engagement des entreprises

L'investissement en recherche et développement, dont les résultats ne sont jamais garantis, présente un risque indéniable. Les entreprises et les entrepreneurs ne s'engageront à acquérir ou à

développer des technologies que si l'investissement offre des perspectives raisonnables de rendement satisfaisant. **L'investissement dans la technologie dépend donc par-dessus tout de la stabilité et de la vigueur économique du pays.**

Par ailleurs, il est essentiel que le gouvernement prenne des mesures favorables à l'engagement des entreprises. **À cet égard, le Canada doit adpoter une politique concurrentielle en matière d'énergie, de propriété intellectuelle, de fiscalité et de règlementation générale des entreprises.**

Le Canada offre une combinaison d'encouragements fiscaux et de subventions qui stimulent ou aident les activités de R-D dans les entreprises. **Il est important que la nature et l'ampleur de ce soutien soient comparables à ce que l'on retrouve dans les pays concurrents .** Le "risque" que comporte le développement pour les entreprises est lié d'une part au coût même de la R-D et, d'autre part, aux délais qui doivent s'écouler avant que le développement se traduise par des recettes tangibles. Il s'agit là d'un problème particulier qui se pose dans de nouveaux domaines, comme la biotechnologie, les céramiques et les matériaux composés perfectionnés, où le risque est si important qu'il mettrait littéralement en jeu l'entreprise. Dans de nombreux pays, le développement entièrement subventionné de technologies de pointe dans le domaine militaire a des retombées commerciales directes très importantes. La politique scientifique et technologique du Canada devrait tenir compte du fait que nous n'accordons pas ici la même priorité à la défense, et mettre en place un mécanisme analogue de partage des risques qui permette aux entreprises d'exercer leurs activités dans d'autres secteurs offrant des retombées intéressantes (p. ex. les matériaux perfectionnés).

Nos écoles de commerce, de sciences et de génie doivent faire en sorte que leurs programmes de premier cycle fassent prendre conscience aux étudiants de la valeur et de l'importance du développement technologique.

3) <u>Personnel qualifié affecté au développement</u>

Les résultats d'une politique scientifique et technologique canadienne seront essentiellement tributaires des qualités du personnel auquel sera confié le développement. Nous devons donc nous assurer les services d'un personnel qualifié et suffisamment

nombreux. Le CRSNG s'est du reste examiné le problème éventuel de la pénurie de personnel qualifié et son importance dans ses documents de planification.

La recherche universitaire joue un rôle essentiel à cet égard, dans la mesure où elle assure la formation de ceux et celles qui s'intégreront au développement industriel et qui, en plus d'avoir acquis une solide connaissance de la méthode scientifique, seront capables de puiser à même les sources de connaissances existantes et de s'en servir. De plus, on ne saurait trop insister sur l'importance qu'il faut accorder à la formation de la nouvelle génération de professeurs.

Il faudra également augmenter les subventions à la recherche universitaire et aux centres de recherche. Pour ce faire, nous encourageons la mise sur pied d'un nombre relativement restreint de centres voués à l'excellence vers lesquels seraient canalisés les fonds.

Dans les universités canadiennes, on constate que le programme de doctorat a été allongé. Nous sommes d'avis qu'il faudrait le ramener à sa durée antérieure (qui était de trois ans après le baccalauréat) pour être capable de former plus d'étudiants et d'encourager les meilleurs éléments à poursuivre leurs études.

4) <u>Installations de développement</u>

Les centres de développement devraient normalement être situés dans l'entreprise qui entreprend les travaux. Ces centres devraient être de très grande qualité et se maintenir à la fine pointe de la technologie.

Dans certains cas, le partage des installations présentent un net avantage :

- les installations nationales uniques (par exemple, soufflerie);
- les installations de développement à contrat, qui offrent les installations matérielles et le personnel qualifié, et se révèlent particulièrement utiles pour les petites entreprises;
- les installations conjointes utilisées par l'université et l'industrie (par exemple, l'équipement analytique spécialisé).

De nos jours le développement doit rapidement déboucher sur la production commerciale. Il est souvent approprié d'utiliser des installations pilotes pour le lancement d'un nouveau produit commercial. **La politique scientifique et technologique devrait encourager ce type de développement et veiller ne pas réduire indûment les incitatifs dont bénéficient les installations de R-D .**

5) Les sources de connaissances

Comme nous l'avons déjà fait remarquer, les sources de connaissances sont, pour la plupart, internationales, et le Canada n'y contribuera que modestement. Il est de la plus haute importance que le personnel affecté au développement puisse avoir accès à cette masse de connaissances. **Notre politique scientifique et technologique doit donc favoriser une utilisation optimale de ces sources par nos chercheurs et techniciens.** C'est pourquoi nous prônons une amélioration constante des structures nécessaires à cette fin.

Étant donné que la contribution scientifique canadienne sera toujours modeste par rapport à l'activité scientifique mondiale, nous devrions concentrer nos efforts sur l'amélioration de la compétitivité industrielle du Canada. En plus d'assurer dans la formation scientifique, la recherche universitaire doit faire avancer la connaissance avec méthode. **C'est uniquement en améliorant les rapports entre les universités et l'industrie que nous pourrons associer plus étroitement la recherche universitaire aux besoins de l'industrie .** La recherche scientifique incombe à l'université, tandis que la recherche industrielle devrait être axée sur le développement et la commercialisation. Il ne faudrait pas, en effet, sous prétexte de rapprocher les universités et l'industrie, limiter les travaux universitaires à des activités de développement à court terme qui délaisseraient la recherche et la formation.

Les sources de connaissances s'étendent bien au-delà des nouvelles découvertes de la science. En fait, l'importance de la "découverte scientifique" dans le progrès industriel, si elle peut être essentielle dans certains cas, est parfaitement négligeable dans d'autres. En revanche, des percées technologiques comme l'ordinateur et les nouveaux matériaux peuvent influer grandement sur l'élaboration de procédés et

de produits améliorés. Notre politique scientifique et technologique doit donc tenir compte de l'ampleur et de l'importance de l'ensemble des sources de connaissances .

Questions connexes

1) R-D gouvernementale

La R-D menée par le gouvernement peut avoir son utilité pour certaines industries fragmentées, comme l'agriculture, mais elle ne constitue pas une stratégie appropriée pour l'industrie en général. C'est pourquoi l'ACFPC endosse la recommandation de l'Association des manufacturiers canadiens (ACM) selon laquelle les gouvernements fédéral et provinciaux, dans l'élaboration d'une politique scientifique et technologique nationale, devraient poser le principe suivant : le gouvernement ne devrait en général pas effectuer de travaux technologiques dans le but d'en transférer ensuite les résultats à l'industrie.

2) Centres de technologie

L'Association canadienne des fabricants de produits chimiques appuient sans réserve les recommandations sur les centres de technologie formulée par l'Association des manufacturiers canadiens dans son document intitulé "Pour accroître notre compétitivité industrielle". En particulier, nous pensons également que toutes les propositions relatives à de nouveaux centres devraient émaner de leurs clients prévus du secteur privé. De cette façon, les nouveaux centres répondront aux besoins de l'industrie tels qu'ils sont perçus par celle-ci et non tels qu'ils sont perçus par le gouvernement. Ces recommandations devraient donner des centres de technologie plus efficaces qui coûteront moins cher aux gouvernements.

DOCUMENT: 830-220/015

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Canadian Forum on a National Science and Technology Policy

Canadian Council of Professional Engineers

June 8-10, 1986
Winnipeg, Manitoba

EXECUTIVE SUMMARY

In order to maintain our high living standards and material prosperity, the Canadian Council of Professional Engineers (CCPE) believes that Canada needs a National Policy on Science and Technology. International competition, global market changes and widespread technological innovations are exerting an undeniable influence on the way every industrialized country organizes its economy. For Canadians, the way ahead will be described by the success we enjoy at managing our inherited wealth, and at creating new wealth. There is an overall pressing need to refine and make better use of what currently exists. Only through a new Science and Technology Policy for Canada, can Canada's wealth and competitiveness be maintained.

In Canada, government policies have been somewhat successful in engendering technology development in industry, universities and government. Unfortunately there is seldom any common thread or direction inherent in the current system. In this context, we welcome the federal government's initiative in setting up a forum to discuss a National Policy for Science and Technology in Canada. The commitments enunciated by the government, i.e. to be more fiscally responsible, to redefine government's role in the economy, to adopt policies fostering investment and innovation, and to implement these changes in an open, compassionate and consistent way, are laudable objectives to which we give our unqualified support.

By the same measure we agree that there is room for improvement and that a new Science and Technology Policy for Canada is imperative. Specifically we would like to see:

MARKET-DRIVEN RESEARCH AND DEVELOPMENT

In Canada research has frequently been undertaken for the sake of research and not to meet the requirements or potential requirements of industry. The CCPE recommends that university and government research become market-driven in order to facilitate effective industrial R&D to support a new science and technology policy in Canada. R&D contacts between government, business and industry must be enhanced to ensure the application of Canadian scientific knowledge to our industrial needs.

TAX INCENTIVES

It is generally accepted that tax incentives are the most effective means to support companies which invest in technology. A recent survey concluded that 86% of companies would have had their R&D programs adversely affected had it not been for federal tax incentives. Tax incentives must be improved by the federal government through extending 100 per cent refundability for unused R&D incentives to all companies. In addition provincial governments must stop taxing federal R&D tax incentives.

DIFFUSION OF TECHNOLOGY

A national science and technology policy requires that an appropriate and effective system for the diffusion of technology be realized as soon as possible. There must be greater collaboration in all sectors of government, academia and industry to ensure that research and development becomes market-driven.

Furthermore, long term planning must become a reality, policy changes must be phased in to minimize disruption in industrial planning, and government agencies involved in R&D must be de-politicized.

UNIVERSITY RESEARCH

Canadian universities, specifically engineering schools and faculties, have suffered significantly over the last ten years due to reduced funds being made available for research equipment and operating grants. Student/professor ratios have grown alarmingly to the point that quality education is threatened. If Canadian researchers cannot undertake research or study effectively, then it is impossible to develop an appropriate national science and technology program. Increased government funding is required immediately to upgrade university research.

GOVERNMENT RESEARCH

Canada is far from receiving maximum benefits from money spent on government laboratories. Government laboratories continue to remain research oriented. Research must be linked with development in order that results can be directed at markets thereby yielding a sensible return on investment. CCPE recommends that government laboratories should be generally restricted to doing R&D to fill government needs. All other government funded research should be contracted out to the private sector.

Canadian Council of Professional Engineers

Conseil Canadien des Ingénieurs

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1936 1986

May 23, 1986

The Honourable Frank Oberle. P.C., M.P.
Minister of State for
Science and Technology
Room 370, West Block
Ottawa, Ontario
K1A 1A1

Dear Mr. Minister:

This is further to my letter of May 14th accepting your invitation to participate at the "Canadian Forum on a National Science and Technology Policy" to be held in Winnipeg on June 8-10, 1986.

I am pleased to enclose for your information and discussion at the Forum the Canadian Council of Professional Engineers' (CCPE) Brief on Science and Technology Policy in Canada.

As I indicated in my earlier correspondence, Mr. Yvon C. Dupuis, ing., our new president and Mr. Anthony P. Pollard will be representing CCPE at the Forum.

As the federation which represents the 125,000 professional engineers in Canada, we recognize the importance of the conference and look forward to participating in the discussions.

Yours truly,

Norman A. Johnson, P.Eng.
President

NAJ/cm
Encls.

Suite 401, 116 Albert,
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BRIEF

CANADIAN FORUM ON A NATIONAL SCIENCE AND TECHNOLOGY POLICY

JUNE 1986

INTRODUCTION

This commentary is submitted by the Canadian Council of Professional Engineers on behalf of the twelve associations that license engineers and oversee the profession in each province and territory; on behalf of the over 125,000 men and women in Canada who are professional engineers. Since 1936, the Council has been serving the profession and public alike through a variety of programs designed to encourage high educational standards, to contribute more knowledge about engineering as an economic activity, and to demystify the role of the engineer in society.

Today our profession has an established presence in virtually every sector and aspect of the economy. Engineers are employed in every industry, in both the public and private sectors, in all provinces and territories, and in positions ranging from trainee to chief executive officer. And yet, unfortunately, we must also acknowledge that some engineers are currently unemployed. Since 1982, many corporations have had to prematurely retire their older, more experienced engineers, and have not been able to hire young graduates from recent engineering classes.

Because engineering activities do generate significant employment opportunities and other benefits here in Canada, we are very concerned about the overall state of science and technology and the capabilities existing within the profession that are not being utilized. While we are working to find solutions to the problems facing our community, we realize that the issues are national in scope. We are confident, however, that as the economy continues to expand, the abilities offered by our profession will be drawn from to continue economic expansion.

It is with these thoughts in mind that the engineering profession welcomes the opportunity to participate in the Forum for the Development of a National Science and Technology Policy. While we recognize that the government has a leading role to play in moderating the nation's science and technology affairs, we believe that its efforts should be directed towards providing leadership and policy direction.

More specifically we see this leadership being reflected in the following ways:

MARKET-DRIVEN: RESEARCH AND TECHNOLOGY	The development of a Canadian science and technology technology policy requires research and development being market-driven.
TAX INCENTIVES:	Primary support for industrial research and development (R&D) must be provided through tax incentives by introducing a series of increasingly more generous tax incentives.
DIFFUSION OF TECHNOLOGY:	A national science and technology policy requires the development of systems whereby there can be an appropriate diffusion of technology.

From our perspective, we urge the government to create a firm foundation for a science and technology policy by fostering a greater sense of confidence in our collective endeavours. To achieve this, we offer our observations in the following pages.

DEVELOPING AND ACQUIRING NEW KNOWLEDGE

UNIVERSITY RESEARCH

Canadian universities, specifically engineering schools and faculties, have suffered significantly over the last ten years due to reduced funds being made available for research equipment. Furthermore, there is a shortage of trained researchers at the MSc and PhD levels which has resulted in a major impediment to attaining the R&D investment target of 1.5 per cent of the gross national product.

Operating grants to researchers in universities are only a fraction of what they should be. Canadian universities are ill-equipped to meet the pressures for more R&D activity and for the turning out of future research leaders. In 1980, the Natural Science and Engineering Research Council (NSERC) embarked upon a detailed analysis of the equipment situation at 16 Canadian universities. The task force concluded that there was a serious shortage of appropriate equipment and that university researchers had become increasingly dependent on NSERC to purchase equipment. The task force recommended that it would be necessary to invest the equivalent of $80 to $90 million (in today's dollars) per year in research equipment not counting operations and maintenance costs. Over the past five years, NSERC increased its investment by a total of $110 million directly through the equipment grants program. In 1985, NSERC was able to respond favorably to 48 per cent of applications for funding, which in turn represent 42 per cent of the dollars requested over five years. In NSERC's Second Five Year Plan, it concludes that it fell $23 million short of funding equipment applications that were well justified and urgent (NSERC's Second Five Year Plan, 1985).

In 1984-85, more than 2,500 undergraduates were awarded NSERC Research Awards to work on R&D projects in a university or industry environment. Applications for NSERC post-graduate scholarships have increased by 70 per cent since 1979. Graduate school enrolment by Canadian citizens and permanent residents has risen from 8,567 to 11,987 in that five year period. In spite of this improvement, Canada remains dependent on non-Canadians for research talent. (NSERC, Second Five Year Plan)

As a result of dwindling resources available to Canadian engineering schools over the last ten years, the ratio of students to professors has increased significantly. According to a study by the Science Council of Canada, the student/professor ratio should normally be 16.1. The ratio is now 23.1. (Science Council of Canada, Engineering Education in Canada: Some Facts and Figures, D. Mascolo, P.W. Wright, G. Slemon, January 1985)

In a paper presented to the Canadian Congress on Engineering Education in London, Ontario on May 12-13, Roland Doré, the Chairman of the National Committee of Deans of Engineering and Applied Science, suggests "the financial resources earmarked for engineering education should be increased by 37.5 per cent in order to offer quality education to our students". Dean Doré, went on to state "this lack of resources translates into over-crowded classrooms, excessive use of teaching assistants, outdated lab equipment and a significant drop in the quality of environment for students at all levels".

The Canadian Council of Professional Engineers believes that R&D including research at universities, must be market-driven. The strategic grants program, and the new program of university-industry awards at NSERC, has succeeded to a certain degree in bringing university research and industry together. In 1984-85, 250 new awards were made under this program, involving $14 million. (NSERC Second Five Year Plan)

CCPE believes that research facilities in universities are sorely lacking. If one cannot research effectively, then it is impossible to develop an appropriate Canadian science and technology program. Government funding is required immediately to upgrade research facilities.

RECOMMENDATIONS

University research must become market-driven in order to facilitate effective industrial R&D to support a new science and technology policy in Canada. The linkages between the private sector and the universities will be enhanced by ensuring that a major component of government funding is market-driven.

The administrators of grant programs must demand evidence from researchers as to the market potential of the work they propose to carry out.

IF NEW MONEY WERE TO BECOME AVAILABLE, SHOULD IT BE USED FOR UNIVERSITY RESEARCH, AND IF SO, HOW SHOULD IT BE SPENT TO ASSURE MAXIMUM BENEFIT TO THE COUNTRY?

CCPE believes that R&D programs in Canada dependent on money, manpower, and interaction between the various sectors doing work. Interaction between government and both universities and industry receives considerable attention. Interaction between industry and the university community does not often receive the attention it should as the basic linkage between scientific research and useful production. As CCPE indicated in its Brief on Research and Development in Canada, in February 1983, 75 per cent of the technology coming out of Canadian universities goes abroad instead of into our domestic market. "University staff and industrial management are often aiming at quite different goals: the former stress research and the latter stress development. Yet each is in a position to help the other if properly attuned."

RECOMMENDATIONS

Arrange periodic meetings between industry and university representatives.

Contribute to the funding of visits, working periods, and sabbatical leaves of university staff with industry.

Allow students to obtain PhD degrees through their work in industry.

Encourage and assist in funding practicing engineers and scientists who are prepared to serve as visiting lecturers at universities.

Create new incentives which reward R&D effort which have proven to be commercially successful. R&D must be closely linked to ensure that innovative research is used to produce marketable products and processes.

Develop a program to promote a linkage between marketing and research and development personnel and a general awareness of the inter-dependence of the two.

HOW CAN OUR ORGANIZATION HELP CANADA TO DEVELOP OUR INTELLECTUAL CAPITAL SO THAT IT CAN BE APPLIED TO CANADA'S NEEDS?

CCPE, as the accreditation body for undergraduate engineering programs in Canada, will continue to ensure high university engineering program standards. CCPE will continue to maintain a syllabi which will ensure properly trained engineers. As well, CCPE, when asked by one of its constituent associations, can encourage government to provide increased funding to university engineering programs, to ensure that equipment facilities and personnel are available to continue to train students.

In instances where a university engineering program has been denied accreditation by CCPE's Canadian Engineering Accreditation Board, the fault often rests with insufficient laboratory equipment as evidenced by the visiting team during accreditation visit.

IS CANADA GETTING MAXIMUM BENEFITS FROM MONEY SPENT ON GOVERENT LABORATORIES?

CCPE believes that Canada is far from receiving maximum benefits. Government laboratories continue to remain research-oriented. Research must be linked with development in order that its results can be directed at markets, thereby yielding a sensible return on investment.

Government laboratory initiatives are too dependent upon the needs of government and universities. They do not respond to the needs of industry. In 1983, NSERC's Committee on Strategic Grants was composed of representatives from universities (55%), industry and consultants (18%) and government (27%). NSERC's Grant Selection Committee was made up of representatives from universities (75%), industry and consultants (18%) and government (7%). The orientation of these committees, particularly to the academic field, is obvious. This is not considered appropriate when the results from strategic grants and applied science grants are intended for the user sector. The emphasis should be placed on having a strong representation by industrial persons whose biases are nurtured by the demands of the market, the work force, shareholders, and the realities of foreign competition.

CCPE supports the Canadian Manufacturers Association (CMA) position that company and not government initiatives should determine what industrial R&D projects are funded by grants. The CMA, in a discussion paper in 1986, recommended that grants generally need simpler administration and increased flexibility to ensure grants fit the needs of the businessman seeking the support rather than the businessman having to fit the requirements of the grant. Internal conflicts in granting agencies that serve more than one purpose should be identified and eliminated so grants are judged only as to whether they make good business sense. (Improving Our Industrial Competitiveness. A Science Policy for Canada. The Canadian Manufacturers Association. February 1986.)

RECOMMENDATIONS

CCPE recommends that all committees concerned with grants having potential industrial applications should have representation of at least 50 per cent from industry and marketing consultants.

CCPE recommends that government laboratories should be generally restricted to doing R&D to fill government needs. All other government funded research should be contracted out to the private sector.

HOW COULD CANADA REALIZE MORE BENEFITS FROM INTERNATIONAL SCIENCE AND TECHNOLOGY DEVELOPMENTS?

CCPE, because of its mandate, cannot undertake a role in international science and technology developments. This is not to say that CCPE does not monitor or encourage international development. CCPE is a member of the World Federation of Engineering Organizations and the Union Panamericana de Asociaciones de Ingenieros. The purpose of our involvement in these international organizations is to ensure that human relations channels remain open.

PUTTING KNOWLEDGE TO WORK AND REALIZING OPPORTUNITIES

SHOULD CANADA TARGET ITS SCIENCE AND TECHNOLOGY RESOURCES IN A RANGE OF STRATEGIC AREAS SO AS TO MAXIMIZE THE RETURN?

Canada must definitely target its R&D resources at specific market opportunities.

Here in Canada, we have a tendency to think that our country is not really a part of the technological scene, and that other countries do all of this innovative work. And yet, many of the things we use either originated here or were improved by Canadians. In the fields of electronic communications, housing, and air transport, we are considered to be world leaders. In other areas, we have produced some remarkable inventions ranging from the snowmobile to the Canadarm.

Despite our successes of the past and current efforts notwithstanding, Canada still has major weaknesses in its science and technology policy. Not enough emphasis is placed on developing our ideas and marketing them. Time and again, people from other countries have taken our brain work and done more with it than we have. The time has come for Canadians to start commercially exploiting the results of our research and development expertise effectively so that we no longer miss out on its economic benefits.

Another weakness is our failure to apply new technology, whether developed in Canada or abroad, to the processes used and products produced by our low and medium technology industries. Often, the very survival of an established industry depends on the adaption of new ideas, techniques and equipment. Moreover, new technology can adapt existing products to new markets and develop new products for old markets.

RECOMMENDATIONS

Canada's research and development resources must be targeted at strategic areas in order that specific market opportunities can be realized.

WHAT CAN OUR ORGANIZATION DO TO IMPROVE METHODS FOR DIFFUSING TECHNOLOGY? CAN OUR ASSOCIATION ENHANCE TECHNOLOGY TRANSFER, MAKING POSSIBLE DEVELOPMENT, COMMERCIALIZATION, FINANCING AND MARKETING IN ALL AREAS OF THE BUSINESS SECTORS?

It is not within CCPE's mandate to undertake such challenges. However, through our close relations with industry and educators of engineers, we will play a role in facilitating interchange between the two.

BY WHAT MECHANISMS COULD GOVERNMENT ENCOURAGE LINKAGES BETWEEN ADVANCED TECHNOLOGY AND MACHINERY COMPANIES ON THE ONE HAND AND THE EXISTING RESOURCE SECTORS ON THE OTHER HAND? WHY DO LINKAGES SEEM INSUFFICIENT AT THE MOMENT, AND WHAT COULD BE DONE ABOUT STRENGTHENING THEM?

It is evident that most of Canada's industries are in "resource-based"--agriculture, fishing, mining, forestry--which means they require below average levels of expenditure and development. While Canada's relatively low level of expenditure on R&D can be explained away in terms of our resource-based economy, there are other factors that re-enforce the situation.

One of the higher profile areas of R&D involves military and National Defence projects. If we look at this type of spending for the United States, we see that it makes up 51 per cent of its R&D effort. Here in Canada though, defence related projects make up only 7 per cent of the total R&D expenditure.

Our R&D level in Canada (1.2% of our G.N.P. in 1984) is affected by the presence of numerous foreign owned companies (53 per cent of our total sales in 1981). These branch plant operations usually rely on their parent companies to do R&D work and consequently carry out very little R&D in Canada.

These factors of our industrial base consisting mostly of resource industries, the limited number of consumer oriented manufacturing firms, and the small amount of R&D being done by Canadian subsidiairies, result in Canada's level of R&D activity being lower than that in many other developed countries. This is not to say that R&D is of little import to Canadian industry. The Conference Board of Canada in a 1986 survey, determined that 3 out 4 companies in Canada believe that the federal government should do more to encourage R&D in the private sector. (Research and Development in the Canadian Sector, a Survey of Attitudes and Spending Intentions, 1986 edition, Conference Board of Canada, February 1986.) R&D in Canada can be enhanced if the federal government implements a proper climate, if it becomes market-oriented, and if industry is provided with financial reward for its endeavours.

RECOMMENDATIONS

Canadian manufacturers must be encouraged and supported in their development of all markets to which they have accesss.

Research and development in Canada must be market-driven.

Tax incentives must be provided to industry to ensure that the latter is rewarded for its R&D incentives.

HOW CAN PRE-VENTURE CAPITAL BE FOSTERED AND TARGETED TO THE HIGH RISK ADVANCED TECHNOLOGY INDUSTRIES? WHAT IS THE PROVINCIAL ROLE AS COMPARED TO THE FEDERAL ROLE?

It is generally accepted that tax incentives are the most effective means to support companies which invest in technology.

Philip A. Lapp Limited, in a 1985 report, stated: "According to firms we interviewed, main barriers to change are financial; insufficient payback and financial problems were most cited." (Philip A. Lapp Limited in association with Currie, Coopers and Lybrand, Technology Transfer in Ontario: Awareness and Program Mechanisms, prepared for the Technology Transfer Section, Innovation and Technology Division, Ministry of Industry, Trade and Technology, September 1985.)

The Macdonald Commission stated: "Tax incentives are generally the most effective means to support most companies investing in technology." The Canadian Manufacturers Association, in its February 1986 discussion paper stated: that: "Tax incentives require improvement and this should be a top priority."

The Conference Board of Canada, in its February 1986 Survey of Attitudes of Canadian Industry in Research and Development concluded: "The most effective instruments with which the federal government can encourage R&D, from the corporate point of view, are tax incentives, grants and contracts." The Conference Board of Canada went on to state: "When asked how their R&D programs would have been affected had the company not used the government incentives, 86% replied that their R&D would have adversely affected. Only 12% of the firms thought that there would have been no affect at all."

While the federal government recognizes the importance of industrial R&D tax incentives, the provincial governments continue to tax R&D incentives, creating an impediment for research and development in Canada. This provincial practice is counter-productive to R&D in Canada.

RECOMMENDATIONS

Tax incentives to industry, thereby rewarding success for research, must be continued and enhanced.

Provincial governments should stop taxing federal R&D tax incentives.

The federal government should extend 100 per cent refundability for unused R&D tax credits for all companies.

WHAT CAN GOVERNMENT DO TO HELP CANADIANS DEAL WITH CHANGES IN ALL ASPECTS OF LIFE WHICH TECHNOLOGICAL CHANGE WILL CONFRONT US WITH IN THE NEXT TWO DECADES? WHAT CAN BE DONE TO DEVELOP A SPIRIT OF COLLABORATION AND WHAT CAN BE DONE TO

PROMOTE GREATER PUBLIC AWARENESS OF AND PARTICIPATION IN THE ISSUES OF SCIENCE AND TECHNOLOGY?

While progress has been made to facilitate greater collaboration between universities, government and industry on the development of a science and technology policy, particularly as it relates to research and development, much remains to be done. The government, in conjunction with industry and university, must develop a system for an appropriate and effective diffusion of technology.

R&D, and science and technology in government are too highly dependent on the political whims of the Minister in charge. Furthermore, there is too high a turnover of Ministers of State for Science and Technology. This has a negative affect on project and program continuity. During the 8 years of the existence of the NSERC, there have 8 different Ministers of State for Science and Technology.

In November, 1985, when the Honourable Frank Oberle replaced the Honourable Tom Siddon as Minister, the switch was announced just 3 days prior to the presentation to Cabinet of NSERC's five year plan. While Mr. Oberle was ultimately able to present NSERC's plan effectively to Cabinet, there were, presumably, many difficulties involved in having the Minister being cognizant of all factors related to the proposal. Continual changes in Ministers of State for Science and Technology result in a lack of long term planning for the department. Each Minister brings to Cabinet his own views of direction for science and technology. Consequently, long range planning becomes difficult.

CCPE is pleased that the Second Five Year Plan for NSERC has been approved. In order for science and technology to become an effective policy in the Canadian mainstream, and in order for it to become market-driven, researchers, developers, and the private sector must have long term planning.

Searching out good ideas is a vital part of R&D. If successful, this process eliminates duplication of effort which is always important, but especially valued where funds and manpower are scarce. In spite of this, the value of information searching does not seem to be well recognized in government policies and programs designed to encourage R&D at relatively small cost. The search phase of R&D is largely dependent on published information. Much of the best information available in a particular field is retained by companies doing R&D for commercial use and is proprietary. However, such companies also maintain libraries from which relevant information can be obtained by others. In the public domaine, Canada is fortunate in having one of the best information retrieval systems in the world--the Canada Institute for Science and Technical Information (CISTI)--a part of the National Research Council of Canada.

The National Research Council has resources available to publicize available information. Through its Technical Information Service (TIS), the NRC can make available to researchers and marketers information on programs it has underway or expects to develop. Currently, this information is not utilized to the extent it should be. Researchers are generally not fully cognizant of all information available within government research branches and granting agencies.

CCPE, through its constituent associations recognizes the utility of the provision of information to the private sector. In June 1985, the Ordre des ingenieurs du Québec, the engineering licensing body in Quebec, put on a week long exhibit at Place Desjardins in Montreal. The purpose of the exhibit was to provide the public and the users of engineering with information on the profession. It was estimated that more than 200,000 people had an opportunity to view the exhibits and displays.

RECOMMENDATIONS

CCPE recommends that a much stronger and closer relationship be established between labour, universities, industries and government. Furthermore, it recommends that the current situation whereby government agencies involved in R&D be de-politicized and that policy changes be phased in to minimize disruption in industrial planning.

Government agencies must be better staffed with individuals who have private sector experience. The executive interchange program should be continued and expanded to promote industry/university interchange.

CCPE recommends that public awareness of science and technology be enhanced through media coverage, competitions, awards of excellence and a higher priority in all levels of government.

In order for research and development to become market-oriented, researchers, developers and the private sector must have long term planning.

CCPE recommends that the CISTI be publicized and promoted through a campaign to publicize its services and their cost. This campaign should include demonstrating to staff and students in university science and engineering courses how to conduct information searches using CISTI and other public and industry libraries; delivering information about CISTI to all companies and organizations known to have a potential interest in R&D; preparing displays for technical conferences so that information retrieval can be illustrated or demonstrated and designing advertisements about CISTI for the print and broadcast media.

CCPE recommends that the NRC Technical Information System be publicized, marketed and expanded through the use of consultants. TIS should mount a campaign to publicize its services. Such a campaign should include direct mail information to all companies and organizations known to have a potential interest in R&D and attractive displays at all technical conferences in Canada with experienced staff to answer questions. Rather than expand the number of employees in the support and service, CCPE recommends that TIS contract out some of its work to consulting firms, working in close cooperation with TIS staff. This will enable technically qualified personnel to assist the small manufacturer by exchanging information in a simple, direct manner. It would also give Canadian consulting firms useful contacts for their services in the small business sector. TIS should charge for their services to recover a part of their cost.

CCPE recommends that NSERC and other granting agencies ensure that researchers write a report of their completed work including the results, implications from industry, possible applications, methods of implementation, market potential, commercial success, and finally, a research bibliography.

CCPE recommends that all government agencies responsible for grants in applied science should require and fund the preparation of a concise paper or abstract on each completed project, suitable for publication in an engineering or trade journal. The cost of such a policy would be minimal and, in many cases, have the effect of putting to use information otherwise lost to Canadian industry.

CCPE recommends that short news items highlighting promised applied research projects be provided, along with the source of more details, for publication in engineering and trade journals. Companies should be encouraged to publicize their commercially successful research and development.

GIVEN MARKET FORCES, THE NEED FOR "CRITICAL MASSES", AND THE TENDENCY OF ADVANCED TECHNOLOGY BUSINESSES TO LOCATE IN CLUSTERS - WHICH LEAD TO CONCENTRATION - WHAT SHOULD BE DONE BY GOVERNMENT AND OTHER SECTORS TO ENSURE REGIONAL BALANCE?

As we noted earlier, science and technology businesses must become more market-oriented. In many instances, for a product to marketed, it must be located near the market place. In addition, science and technology businesses are generally located where much research and development takes place. For this reason, businesses generally locate near centres of educational excellence.

Unfortunately, considerable science and technology programs in Canada are not market-driven and their support by government is highly politicized. In the past, science and technology has been used by politicians as a method of meeting political promises in their respective regions of responsibility. Politicians have the power to shift bureaucracies and resources to various parts of the country. While the advisability of relocating government departments to remote parts of the country may be moot, relocation generally does not affect the effectiveness of a department. The same cannot be said for science and technology industries.

RECOMMENDATIONS

CCPE recommends that science and technology companies be market driven and that technology based enterprises should be located in clusters and near centers of educational excellence.

WHAT MEASURES NEED TO BE TAKEN TO ENHANCE THE JOINT COLLABORATION OF LABOUR AND MANAGEMENT IN THE INTRODUCTION OF NEW TECHNOLOGIES?

The competitiveness of Canadian industry in foreign markets is dependent upon the collaboration of labour to ensure that it is as productive as possible. Advanced technology is dependent upon the efficiencies of the work force. As always, labour remains a vital component of Canadian industry. For this reason, increased collaboration between labour and management is vital for the development of Canadian science and technology. Labour can contribute in the mar-

keting of products emanating from new technologies by recognizing their role and ensuring productivity and the competitiveness of their products.

RECOMMENDATIONS

CCPE recommends that labour play a more important role in decision making in science and technology development. For example, we recommend that labour representatives assume a more important role in management decisions by sitting on the boards of directors of various government agencies and crown corporations such as CN, the St. Lawrence Seaway, and AECL.

CCPE recommends that profit sharing plans be considered as one approach to encourage labour to take a greater interest in, and assume some of the risk in the development and marketing of new scientific and technological products.

PUTTING A NATIONAL SCIENCE AND TECHNOLOGY STRATEGY TO WORK

IN THE SUCCESSFUL DEVELOPMENT AND IMPLEMENTATION OF A NATIONAL SCIENCE AND TECHNOLOGY POLICY, WHAT ARE THE RESPECTIVE ROLES OF THE FEDERAL GOVERNMENT, PROVINCIAL GOVERNMENT, UNIVERSITIES, THE PRIVATE SECTOR, LABOUR, AND OUR ORGANIZATION?

To meet the challenges and opportunities of science and technology in Canada, we must increase our capability to exploit the resources available today and to ensure that they are adapted and enhanced to meet the future needs of Canada.

As outlined, CCPE believes there are 3 tenets to the successful development of a national science and technology policy namely:

- o Research and development in Canada must be become market-driven.

- o Greater financial incentives must be created which are based on successful commercial exploitation of research and development. Tax incentives must be continued and enhanced to ensure that industry invests in technology.

- o Canada must develop a system whereby there is an appropriate diffusion of technology.

Federal, provincial and territorial governments must work together to ensure that the private sector increases its investments, research, developments, and innovation. The existing Economic and Regional Development Agreements provide the foundation for federal/provincial development of science and technology. Unfortunately, because of the federal nature of our country, there are many areas where differences arise. While education is a provincial responsibility and the provinces posess the authority to make decisions regarding educational facilities, the federal government contributes significantly through transfer payments as well as grants and operating subsidies. Collaboration is necessary.

RECOMMENDATIONS

CCPE recommends that there be increased collaboration between the federal and provincial governments as well as universities, labour and industry in order to facilitate the development of a science and technology policy for Canada. This collaboration must take into account CCPE's aforementioned recommendations of R&D being market-driven, tax incentives for industry, and the development of a system of diffusion of technology.

DOCUMENT: 830-220/015

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Colloque canadien sur la politique relative à la science et à la technologie

Conseil canadiens des ingénieurs

le 8-10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

RÉSUMÉ

Le Conseil canadien des ingénieurs est d'avis que pour conserver son niveau de vie élevé et sa prospérité, le Canada doit se doter d'une politique nationale en matière de science et de technologie. La concurrence internationale, l'évolution du marché mondial et l'ampleur de l'innovation technologique exercent une influence indéniable sur la façon dont chaque pays industrialisé organise son économie. Pour nous, Canadiens, le progrès dépendra de notre capacité de gérer la richesse dont nous avons hérité et d'en créer une nouvelle. Nous avons un urgent besoin de parfaire nos acquis et de les utiliser à meilleur escient. Seule une politique nationale sur la science et la technologie permettra au Canada de maintenir sa richesse et sa compétitivité.

Au Canada, les politiques gouvernementales ont réussi jusqu'à un certain point à assurer le développement technologique des secteurs industriel, universitaire et gouvernemental. Malheureusement, on retrouve rarement de fil conducteur ou d'orientation commune dans le système actuel. C'est pour cette raison que nous nous réjouissons du fait que le gouvernement ait pris l'initiative d'organiser un colloque national sur l'élaboration d'une politique nationale de science et de technologie pour le Canada. Les engagements pris par l'État, à savoir : responsabilité financière accrue, redéfinition du rôle de l'État dans l'économie, adoption de politiques favorisant l'investissement et l'innovation, et mise en oeuvre de ces changements avec franchise, compassion et uniformité, constituent des objectifs louables auxquels nous adhérons sans réserve.

De même, nous convenons qu'il y a place à l'amélioration et que l'adoption d'une politique canadienne sur la science et la technologie est un besoin impérieux. Voici d'ailleurs les recommandations que nous formulons à cet égard.

RECHERCHE ET DÉVELOPPEMENT ORIENTÉES EN FONCTION DES BESOINS DU MARCHÉ

Au Canada, la recherche s'effectue souvent en vase clos, sans chercher à satisfaire aux exigences présentes ou éventuelles d'un secteur industriel donné. Le CCI recommande que la recherche universitaire et gouvernementale soit dorénavant orientée en fonction des besoins du marché, de façon à faciliter le processus d'implantation d'une R-D industrielle qui viendrait soutenir une nouvelle politique de science et de technologie au Canada. Il faut améliorer les contacts entre l'État, le monde des affaires et les milieux industriels, en matière de R-D, de façon que les connaissances scientifiques canadiennes servent à combler les besoins de nos industries.

STIMULANTS FISCAUX

De l'aveu général, les stimulants fiscaux sont le meilleur moyen d'appuyer les entreprises qui investissent dans la technologie. Un récent sondage a révélé que l'absence des stimulants fiscaux consentis par le gouvernement fédéral aurait eu un impact négatif sur les programmes de R-D de 86 p. 100 des entreprises. Il importe donc que le gouvernement fédéral améliore les stimulants fiscaux en élargissant à toutes les entreprises la possibilité de remboursement intégral de la portion non utilisée des crédits d'impôt relatifs à la R-D.

DIFFUSION DE LA TECHNOLOGIE

L'adoption d'une politique nationale sur la science et la technologie suppose la mise en place dans les meilleurs délais d'un mécanisme approprié et efficace de diffusion de la technologie. Il importe que tous les secteurs gouvernementaux, universitaires et industriels collaborent davantage, pour faire en sorte que la recherche et le développement répondent aux impératifs du marché.

Il faut en outre que la planification à long terme devienne une réalité, que la transformation des politiques soit progressive, de manière à déranger le moins possible la planification industrielle, et que les organismes gouvernementaux intervenant dans la R-D soient dépolitisés.

RECHERCHE UNIVERSITAIRE

Les universités canadiennes, et plus spécialement les écoles et les facultés de génie, ont beaucoup souffert depuis dix ans de la diminution des sommes consacrées à l'équipement de recherche ainsi que des subventions de fonctionnement. Les rapports étudiants/professeur se sont accrus de façon alarmante, au point de constituer une menace à la qualité de l'enseignement. Si les chercheurs canadiens ne peuvent entreprendre des recherches ou des études de manière efficace, il sera impossible de réaliser un programme national de science et de technologie approprié. L'amélioration de la recherche universitaire passe donc par une augmentation immédiate du financement public.

RECHERCHE GOUVERNEMENTALE

Le Canada est loin de tirer des avantages maximums des budgets consacrés aux laboratoires d'État, qui demeurent en effet uniquement axés sur la recherche. Il importe que la recherche soit associée au développement, de façon que les résultats en soient appliqués au marché et que nos investissements nous procurent un rendement raisonnable. Le CCI recommande que, de manière générale, les laboratoires d'État se bornent à faire de la R-D pour répondre aux besoins du secteur public. Tous les autres travaux de recherche financés par l'État devraient être confiés à des sous-traitants du secteur privé.

INTRODUCTION

Ce mémoire est présenté par le Conseil canadien des ingénieurs au nom des 12 associations qui réglementent et supervisent la profession d'ingénieur dans chacune des provinces et chacun des territoires, ainsi qu'au nom de plus de 125 000 hommes et femmes qui exercent la profession d'ingénieur au Canada. Le Conseil sert les membres de la profession et la population depuis 1936, au moyen de divers programmes visant à favoriser la meilleure formation technique possible, à bien faire comprendre la place qu'occupe le génie dans notre économie et à démystifier le rôle de l'ingénieur dans la société.

De nos jours, notre profession intervient dans pratiquement tous les secteurs et chacun des aspects de l'économie. Les ingénieurs sont présents dans toutes les industries, dans le secteur public comme dans le secteur privé, dans toutes les provinces et dans les deux territoires et à tous les échelons de la hiérarchie, depuis celui de stagiaire jusqu'à celui de p.-d.g. Et pourtant, force nous est de constater que certains ingénieurs sont actuellement réduits au chômage. Depuis 1982, de nombreuses entreprises ont été contraintes de mettre prématurément à la retraite leurs ingénieurs les plus âgés et les plus expérimentés, sans toutefois être en mesure de recruter de jeunes diplômés.

Comme les travaux de génie génèrent de nombreuses possibilités d'emploi et d'autres avantages, ici même au Canada, nous sommes très préoccupés par l'état global de la science et de la technologie et par les possibilités non exploitées de notre profession. En dépit du fait que nous nous employons à trouver des solutions aux problèmes auxquels notre profession est confrontée, nous constatons que les problèmes ont une ampleur nationale. Nous sommes toutefois persuadés qu'au fur et à mesure que l'expansion économique se poursuivra, on fera appel à nos compétences afin de maintenir notre économie sur sa lancée.

C'est dans cette optique que notre profession se réjouit de la possibilité qui lui est donnée de prendre part au Colloque pour l'élaboration d'une politique nationale de la science et de la technologie. Si nous reconnaissons volontiers que l'État a un rôle d'animateur à jouer en ce qui concerne les questions de science et de technologie à l'échelle du pays, nous croyons que ses efforts devraient viser à assurer une direction et à orienter le mécanisme d'élaboration des politiques.

Voici, de façon plus précise, comment ce rôle de direction devrait à notre avis se manifester.

RECHERCHE ET TECHNOLOGIE AXÉES SUR LES BESOINS DU MARCHÉ :	L'élaboration d'une politique canadienne sur la science et la technologie suppose que la recherche et le développement soient orientés en fonction des besoins du marché.
STIMULANTS FISCAUX :	Le soutien de la recherche et du développement industriels (R-D) doit d'abord être assuré au moyen de stimulants fiscaux, c'est-à-dire au moyen d'une série de stimulants fiscaux de plus en plus généreux.

DIFFUSION DE LA TECHNOLOGIE : L'adoption d'une politique nationale sur la science et la technologie suppose la mise en place de mécanismes permettant une diffusion adéquate de la technologie.

Pour notre part, nous exhortons le gouvernement à donner des assisses solides à la politique sur la science et la technologie, en instaurant un climat apte à susciter une confiance accrue dans nos travaux collectifs. Nous formulons dans les pages qui suivent diverses observations sur les moyens de parvenir à cette fin.

<u>DÉVELOPPEMENT ET ACQUISITION DE NOUVELLES CONNAISSANCES</u>

<u>RECHERCHE UNIVERSITAIRE</u>

Les universités canadiennes, et plus spécialement les écoles et les facultés de génie, ont beaucoup souffert depuis dix ans de la diminution des sommes consacrées à l'équipement de recherche. La pénurie de chercheurs possédant une maîtrise ou un doctorat a de plus constitué un obstacle majeur à l'atteinte de l'objectif visant à consacrer 1,5 p. 100 du produit national brut aux investissements en R-D.

Les subventions de fonctionnement consenties aux chercheurs universitaires sont largement insuffisantes. Les universités canadiennes sont mal équipées pour faire face au besoin pressant d'une intensification des activités de R-D et pour produire les futurs chefs de file en matière de recherche. En 1980, le Conseil de recherches en sciences naturelles et en génie (CRSNG) s'est livré à une analyse détaillée du niveau d'équipement de 16 universités canadiennes. Le groupe de travail formé à cette fin en est venu à la conclusion qu'il existait une grave pénurie d'équipement approprié et que les chercheurs universitaires dépendaient de plus en plus du CRSNG pour l'acquisition d'équipement. Le groupe de travail estimait qu'il faudrait investir chaque année de 80 à 90 millions de dollars (courants) dans l'équipement de recherche, sans compter les frais de fonctionnement et d'entretien. Au cours des cinq dernières années, le CRSNG a accru ses investissements de 110 millions de dollars, par l'intermédiaire direct du programme de subventions à l'équipement. En 1985 le CRSNG a été en mesure d'apporter une réponse favorable à 48 p. 100 des demandes de financement, ce qui représente 42 p. 100 des sommes demandées en cinq ans. Dans son second plan quinquennal, le Conseil conclut qu'il lui a manqué 23 millions de dollars pour financer des acquisitions d'équipement qui étaient pourtant justifiées et urgentes (<u>Deuxième plan quinquennal du CRSNG</u>, 1985).

En 1984-1985, plus de 2 500 diplômés du premier cycle ont reçu des subventions de recherche du CRSNG afin de se consacrer à des projets de R-D en milieu universitaire ou industriel. Le nombre des demandes de bourses de maîtrise ou de doctorat présentées au CRSNG s'est accru de 70 p. 100 depuis 1979. Au cours de cette période de cinq ans, le nombre de citoyens canadiens et de résidents permanents inscrits aux programmes de maîtrise et de doctorat est passé de 8 567 à 11 987. En dépit de cette amélioration, le Canada demeure tributaire de talents non canadiens dans le domaine de la recherche (CRSNG, Deuxième plan quinquennal).

Par suite de la diminution des ressources mises à la disposition des écoles canadiennes de génie depuis 10 ans, le rapport étudiants/professeur s'est accru de manière significative. D'après une étude réalisée par le Conseil des sciences du Canada, ce rapport, qui devrait normalement être de 16.1, est actuellement de 23.1 (Conseil des sciences du Canada, <u>Formation en génie au Canada : Faits et chiffres</u>, D. Mascolo, P.W. Wright, G. Slemon, janvier 1985).

Dans un document présenté à l'occasion du Congrès canadien de la formation en génie, tenu à London (Ontario), les 12 et 13 mai, M. Roland Doré, président du Comité national des doyens des facultés de génie et de sciences appliquées, suggère que les ressources financières réservées à la formation en génie soient augmentées de 37,5 p. 100, de manière à assurer une formation de qualité à nos étudiants. Il ajoute que la pénurie de ressources se traduit par des classes surpeuplées, un recours abusif aux attachés de recherche, du matériel de laboratoire désuet et une diminution importante de la qualité de l'environnement pour les étudiants de tous les niveaux.

Le Conseil canadien des ingénieurs croit que la R-D, y compris la recherche universitaire, doit être orientée en fonction des besoins du marché. Le programme de subventions stratégiques, ainsi que le nouveau programme université-industrie, lancé par le CRSNG, réussissent jusqu'à un certain point à faire concorder la recherche universitaire et les besoins de l'industrie. En 1984-1985, 250 nouveaux prix totalisant 14 millions de dollars ont été accordés en vertu de ce programme (Deuxième plan quinquennal du CRSNG).

Le CCI estime que les installations de recherche font gravement insuffisantes dans nos universités. À défaut de pouvoir faire de la recherche convenablement, il sera impossible d'élaborer un programme adéquat de science et de technologie pour le Canada. Il importe donc que le gouvernement consacre immédiatement des ressources financières à l'amélioration des installations de recherche.

RECOMMANDATIONS

Il faut que la recherche universitaire soit orientée en fonction des besoins du marché afin de favoriser une R-D industrielle efficace qui servira de soutien à une nouvelle politique de science et de technologie au Canada. En faisant en sorte qu'un élément important du financement public soit orienté sur la satisfaction des besoins du marché, on favorisera un rapprochement entre le secteur privé et les universités.

Il importera que les administrateurs de programmes de subventions demandent aux chercheurs de faire la preuve du potentiel commercial des travaux qu'ils proposeront d'exécuter.

SI DE NOUVELLES RESSOURCES ÉTAIENT DISPONIBLES, DEVRAIENT-ELLES ÊTRE CONSACRÉES À LA RECHERCHE UNIVERSITAIRE, ET, DANS L'AFFIRMATIVE, DE QUELLE FAÇON DEVRAIENT-ELLES ÊTRE ENGAGÉES POUR QUE LE PAYS EN TIRE DES AVANTAGES MAXIMUMS?

Le CCI croit que les programmes canadiens de R-D sont tributaires des ressources financières et humaines ainsi que de l'interaction des divers secteurs qui accomplissent le travail. L'interaction entre l'État, d'une part, et les universités et l'industrie, d'autre part, fait l'objet d'une attention considérable. Par contre, l'interaction entre le milieu industriel et le monde universitaire ne reçoit souvent pas toute l'attention qu'elle devrait en tant que maillon essentiel entre la recherche scientifique et la production de biens utiles. Comme le CCI l'indiquait dans son Mémoire sur la recherche-développement au Canada, en février 1983,

75 p. 100 de la technologie provenant des universités canadiennes est exportée à l'étranger au lieu d'être exploitée ici. Les administrateurs d'universités et les dirigeants d'entreprises industrielles poursuivent souvent des buts fort différents : les premiers mettent l'accent sur la recherche, les seconds, sur le développement. Néanmoins, chacun est en mesure d'aider l'autre, à la condition que les deux soient sur la même longueur d'ondes.

RECOMMANDATIONS

Organiser des rencontres périodiques entre représentants des milieux industriels et universitaires.

Contribuer au financement des visites, stages et congés sabbatiques du personnel universitaire dans les industries.

Permettre aux étudiants d'obtenir leur doctorat au moyen de stages industriels.

Encourager et aider financièrement les ingénieurs et scientifique en exercice qui sont disposés à accepter des charges de conférenciers dans des universités.

Créer de nouveaux stimulants en faveur de la R-D présentant des possibilités commerciales manifestes. Il importe que la recherche et le développement soient intimement liés pour faire en sorte que la recherche à caractère innovateur serve à concevoir des produits et procédés commercialisables.

Élaborer un programme visant à susciter un rapprochement entre le personnel des services de commercialisation et celui des services de R-D, de même qu'à sensibiliser ce dernier à l'interdépendance de ces deux services.

DE QUELLE FAÇON NOTRE ORGANISATION PEUT-ELLE AIDER LE CANADA À DÉVELOPPER NOTRE CAPITAL INTELLECTUEL DE FAÇON QU'IL PUISSE SERVIR À LA SATISFACTION DES BESOINS DU CANADA?

Le CCI, en sa qualité d'organisme responsable de l'accréditation des programmes d'études de premier cycle en génie au Canada, continuera d'assurer l'application de normes rigoureuses dans ce domaine. Le CCI maintiendra des syllabus propres à assurer la formation adéquate des ingénieurs. Le CCI peut en outre, lorsque l'une de ses associations constituantes en fait la demande, encourager l'État à accroître son financement des programmes de formation universitaire en génie, afin de s'assurer que l'on dispose des installations et du personnel nécessaires pour continuer à former des étudiants.

Lorsque le Bureau canadien d'accréditation, qui relève du CCI, refuse d'accréditer un programme d'études universitaires en génie, la cause en est souvent l'insuffisance de l'équipement de laboratoire, constatée lors de la visite de l'équipe d'accréditation.

LE CANADA TIRE-T-IL DES AVANTAGES MAXIMUMS DES SOMMES CONSACRÉES AUX LABORATOIRES D'ÉTAT?

Le CCI croit que le Canada est loin de tirer des avantages maximums de ses laboratoires d'État. Ceux-ci demeurent en effet orientés en fonction de la recherche. Or, il faut que la recherche soit associée au développement pour que ses résultats puissent être commercialisés, et assurer ainsi un rendement raisonnable de nos investissements.

Les initiatives prises par les laboratoires d'État sont trop largement axées sur les seuls besoins de l'État et des universités et ne cadrent pas avec les besoins du secteur industriel. En 1983, le Comité des subventions stratégiques du CRSNG était composé de représentants des universités (55 p. 100), de représentants des milieux industriels et d'experts-conseils (18 p. 100) et de représentants de l'administration publique (7 p. 100). L'orientation de ces comités, spécialement à l'égard du secteur universitaire, est évidente, ce qui apparaît comme inopportun, compte tenu du fait que les résultats des subventions stratégiques et des subventions consenties pour les sciences appliquées sont destinées au secteur des utilisateurs. Il conviendrait de privilégier une forte représentation des milieux industriels, étant donné que leurs positions reflètent les exigences du marché, la composition de la population active, les volontés de leurs actionnaires et les réalités de la concurrence étrangère.

Le CCI convient avec l'Association des manufacturiers canadiens (AMC) que ce sont les initiatives de l'entreprise privée et non pas celles de l'État qui devraient déterminer quels projets de R-D feront l'objet de subventions. Dans un document de travail qu'elle a publié en 1986, l'AMC recommandait que l'administration des subventions soit simplifiée et assouplie, de façon que les subventions correspondent aux besoins des gens d'affaires qui en font la demande plutôt que d'obliger les gens d'affaires à se plier aux conditions d'octroi des subventions. Il conviendrait également de déceler et éliminer les conflits internes au sein des organismes de subventions qui poursuivent plus d'un objectif, de manière que les subventions ne soient consenties qu'en fonction de leur intérêt commercial. (Improving Our Industrial Competitiveness - A Science Policy for Canada. L'Association des manufacturiers canadiens, février 1986.)

RECOMMANDATIONS

Le CCI recommande que tous les comités ayant à décider de subventions pouvant avoir une incidence sur l'industrie comptent au moins 50 p. 100 de représentants des milieux industriels et d'experts-conseils.

Le CCI recommande que les laboratoires d'État se limitent, de manière générale, à la R-D correspondant aux besoins de l'État. Tous les autres projets de recherche financés par l'État devraient être confiés à des sous-traitants du secteur privé.

COMMENT LE CANADA POURRAIT-IL TIRER PLUS D'AVANTAGES DES PROGRÈS DE LA SCIENCE ET DE LA TECHNOLOGIE À L'ÉCHELLE INTERNATIONALE?

Le Canada doit absolument orienter ses ressources en R-D de façon à exploiter certaines possibilités du marché.

Les Canadiens ont tendance à croire que leur pays n'a pas vraiment de rôle à jouer en matière de technologie, et que toute innovation nous vient de l'étranger. Et pourtant, nombreux sont les objets que nous utilisons qui ont été inventés ou améliorés par des Canadiens. Dans les secteurs des communications électroniques, de l'habitation et du transport aérien, par exemple, le Canada est considéré comme un chef de file mondial. Dans d'autres domaines, nous avons produit des inventions remarquables, allant de la motoneige au bras télémanipulateur qui équipe les navettes spatiales.

Or, en dépit de nos succès antérieurs et de nos efforts actuels, la politique du Canada en matière de science et de technologie souffre encore de lacunes graves. Nous n'attachons pas suffisamment d'importance à la mise en valeur et à la commercialisation de nos idées. Maintes et maintes fois, les étrangers ont pris nos idées et les ont exploitées mieux que nous. Le temps est venu pour les Canadiens de commencer à exploiter commercialement les résultats de nos efforts de recherche et de développement, de façon à cesser d'en perdre les avantages économiques.

Une autre de nos lacunes tient à notre incapacité d'appliquer les technologies nouvelles - qu'elles aient été mises au point au Canada ou à l'étranger - aux procédés et aux produits de nos industries faisant peu ou moyennement appel à la technologie. Il arrive fréquemment en effet que la survie même d'une industrie établie dépende de l'adoption d'idées, de techniques et d'équipement nouveaux. De plus, les technologies nouvelles peuvent contribuer à l'adaptation de produits existants à de nouveaux marchés et à la mise au point de nouveaux produits pour des marchés existants.

RECOMMANDATIONS

Les ressources canadiennes en matière de recherche et de développement doivent être affectées à des domaines stratégiques de façon à permettre la réalisation de possibilités commerciales spécifiques.

QUE PEUT FAIRE NOTRE ORGANISATION POUR AMÉLIORER LA DIFFUSION DE LA TECHNOLOGIE? NOTRE ASSOCIATION PEUT-ELLE AMÉLIORER LES TRANSFERTS DE TECHNOLOGIE, ET RENDRE LE DÉVELOPPEMENT, LA COMMERCIALISATION ET LE FINANCEMENT POSSIBLES DANS TOUS LES SECTEURS DES AFFAIRES?

Il n'entre pas dans le mandat du CCI de relever de tels défis. Toutefois, grâce aux liens étroits que nous entretenons avec les représentants des milieux industriels et avec les responsables de la formation des ingénieurs, nous serons en mesure de faciliter les échanges entre ces derniers.

PAR QUELS MÉCANISMES L'ÉTAT POURRAIT-IL FAVORISER LES RAPPROCHEMENTS ENTRE, D'UNE PART, LES ENTREPRISES FAISANT APPEL À DES TECHNOLOGIES ET À

DES APPAREILS DE POINTE, ET, D'AUTRE PART, LES SECTEURS UTILISANT LES RESSOURCES EXISTANTES? POUR QUELLE RAISON LES LIENS SEMBLENT-ILS INSUFFISANTS À L'HEURE ACTUELLE ET QUE POURRAIT-ON FAIRE POUR LES RESSERRER?

Il est évident que la plupart des industries canadiennes (agriculture, pêche, exploitation minière et foresterie) sont "fondées sur les ressources", ce qui signifie qu'elles nécessitent des niveaux de dépenses et de développement inférieurs à la moyenne. Bien que le niveau relativement peu élevé des dépenses de R-D au Canada tienne en partie au fait que notre économie repose sur l'exploitation des ressources, d'autres facteurs expliquent aussi la situation.

L'un des secteurs les plus en vue de la R-D est celui qui a trait aux projets militaires et de la Défense nationale. Si l'on examine ce type de dépenses pour les États-Unis, on constate qu'il y accapare 51 p. 100 de l'effort de R-D. Au Canada, par contre, les projets liés à la défense ne représentent que 7 p. 100 du total des dépenses de R-D.

Le niveau de R-D au Canada (1,2 p. 100 de notre PNB en 1984) subit l'influence de la présence de nombreuses entreprises étrangères (53 p. 100 de nos ventes totales en 1981). Ces succursales comptent habituellement sur leurs sociétés mères pour la R-D, et en font donc très peu au Canada.

Tous ces facteurs - base industrielle surtout constituée d'industries de mise en valeur des ressources, nombre limité d'entreprises de fabrication de biens de consommation et faible quantité de R-D effectuée par les filiales canadiennes - ont pour effet que le niveau de R-D est moins élevé au Canada que dans de nombreux autres pays développés. Ce qui ne veut pas dire que la R-D a peu d'importance pour l'industrie canadienne. Le Conference Board du Canada a procédé en 1986 à un sondage qui a révélé que 3 dirigeants d'entreprises sur 4 au Canada estiment que le gouvernement fédéral devrait faire davantage pour favoriser la R-D dans le secteur privé. (Research and Development in the Canadian Sector, a Survey of Attitudes and Spending Intentions, 1986 edition, Conference Board of Canada, février 1986.) La R-D pourrait s'améliorer au Canada si le gouvernement fédéral instaurait un climat favorable, si la R-D était dorénavant orientée en fonction des besoins du marché et si l'industrie était financièrement récompensée pour ses efforts.

RECOMMANDATIONS

Il faut encourager et appuyer les manufacturiers canadiens dans le développement de tous les marchés auxquels ils ont accès.

Il faut que la recherche et le développement au Canada soient orientés en fonction des besoins du marché.

Il faut consentir des stimulants fiscaux aux industries pour s'assurer qu'elles soient récompensées pour leurs efforts de R-D.

COMMENT PEUT-ON FAVORISER L'INVESTISSEMENT DE CAPITAL DE RISQUE DANS LES INDUSTRIES À RISQUES ÉLEVÉS UTILISANT DES TECHNOLOGIES DE POINTE? QUEL EST LE RÔLE DES GOUVERNEMENTS PROVINCIAUX PAR RAPPORT À CELUI DU GOUVERNEMENT FÉDÉRAL?

On reconnaît généralement que les stimulants fiscaux constituent le meilleur moyen de soutenir les entreprises qui investissent dans la technologie.

Dans un rapport publié en 1985, les dirigeants de la société Philip A. Lapp Limited déclaraient que selon les responsables d'entreprises qu'ils avaient interrogés, les principaux obstacles au changement étaient d'ordre financier, et ceux qui revenaient le plus souvent étaient les avantages insuffisants et les problèmes financiers. (Philip A. Lapp Limited, en collaboration avec Currie, Coopers and Lybrand, Technology Tranfer in Ontario: Awareness and Program Mechanisms, rédigé pour le compte de la Section des transferts de technologie, Division de l'innovation et de la technologie, ministère ontarien de l'Industrie, du Commerce et de la Technologie, septembre 1985.)

La Commission Macdonald a déclaré que les stimulants fiscaux sont en général le moyen le plus efficace d'appuyer les entreprises qui investissent dans la technologie, alors que dans son rapport de février 1986, l'Association des manufacturiers canadiens affirmait que les stimulants fiscaux nécessitent une amélioration, et que celle-ci devrait constituer une priorité absolue.

Dans son document de février 1986, intitulé Survey of Attitudes of Canadian Industry in Research and Development, le Conference Board du Canada en venait à la conclusion que les instruments les plus efficaces dont dispose le gouvernement fédéral pour encourager la R-D, du point de vue des entreprises, sont les stimulants fiscaux, les subventions et les marchés de services. Le document ajoutait qu'à la question de savoir si leur programme de R-D aurait souffert s'ils n'avaient pas eu recours aux stimulants consentis par l'État, 86 p. 100 des dirigeants d'entreprises interrogés ont répondu par l'affirmative. Seulement 12 p.100 ont estimé que leur programme n'en aurait pas souffert du tout.

Si le gouvernement fédéral reconnaît l'importance des stimulants fiscaux pour la R-D industrielle, les gouvernements provinciaux continuent de prélever des impôts sur les stimulants à la R-D. Cette mesure provinciale nuit à la R-D au Canada.

RECOMMANDATIONS

Il importe que les stimulants fiscaux consentis à l'industrie, qui constituent un moyen de récompenser les efforts de recherche, soit maintenus et améliorés.

Les gouvernements provinciaux doivent cesser de prélever des impôts sur les stimulants fiscaux consentis par le gouvernement fédéral au titre de la R-D.

Le gouvernement devrait étendre à toutes les entreprises le remboursement intégral de la portion inutilisée des crédits d'impôt pour la R-D.

QUE PEUT FAIRE L'ÉTAT POUR AIDER LES CANADIENS À S'ADAPTER AUX CHANGEMENTS QUE LES PROGRÈS TECHNOLOGIQUES PRODUIRONT DANS TOUS LES ASPECTS DE LA VIE AU COURS DES DEUX PROCHAINES DÉCENNIES? QUE PEUT-ON FAIRE POUR INSTAURER

UN CLIMAT DE COLLABORATION ET POUR INTÉRESSER DAVANTAGE LA POPULATION AUX QUESTIONS LIÉES À LA SCIENCE ET LA TECHNOLOGIE?

Bien que des progrès aient été réalisés pour faciliter une plus grande collaboration entre les universités, l'État et l'industrie en vue de l'élaboration d'une politique sur la science et la technologie, notamment pour ce qui a trait à la recherche et au développement, il reste encore beaucoup à faire à cet égard. Il importe que l'État mette en place, de concert avec les milieux industriels et universitaires, un système propre à assurer une diffusion appropriée et efficace de la technologie.

Au sein de l'appareil gouvernemental, la R-D, ainsi que la science et la technologie, sont trop largement tributaires des caprices politiques du ministre responsable. De plus, les ministres d'État chargés des Sciences et de la Technologie se succèdent à un rythme trop rapide, ce qui a un effet négatif sur la continuité des projets et des programmes. Au cours huit années d'existence du CRSNG, le ministère d'État chargé des Sciences et de la Technologie a eu huit titulaires.

En novembre 1985, l'annonce du remplacement de l'honorable Tom Siddon par l'honorable Frank Oberle à la tête du Ministère a précédé de trois jours seulement la présentation du plan quinquennal du CRSNG au Cabinet. Bien que M. Oberle soit parvenu à le présenter malgré tout, l'informer de tous les facteurs relatifs à la proposition a apparemment posé de nombreuses difficultés. Le changement continuel des ministres d'État chargés des Sciences et de la Technologie empêche le Ministère de planifier à long terme, chaque ministre ayant sa propre conception de la façon dont la science et la technologie devraient évoluer.

Le CCI se réjouit de l'approbation du deuxième plan quinquennal du CRSNG. Pour que la politique sur la science et la technologie devienne une politique efficace et intégrée aux autres politiques nationales, et pour qu'elle soit orientée en fonction des besoins du marché, il faut que les chercheurs, les promoteurs et le secteur privé puissent compter sur une planification à long terme.

La recherche de bonnes idées constitue un élément vital de la R-D. Lorsque couronné de succès, ce processus élimine le dédoublement des efforts, ce qui est toujours important, mais encore plus précieux lorsque les ressources humaines et financières se font rares. En dépit de ce fait, la valeur de la recherche d'information ne semble pas être pleinement reconnue dans les politiques et programmes gouvernementaux, qui visent à encourager la R-D moyennant un coût relativement réduit. La phase recherche de la R-D dépend pour beaucoup de l'information publiée. Or, la meilleure documentation disponible dans un domaine particulier est conservée par les entreprises qui font de la recherche à des fins commerciales et est protégée par des droits d'auteur. Toutefois, ces entreprises possèdent également des bibliothèques où les autres sociétés peuvent puiser des renseignements pertinents. En ce qui concerne le domaine public, le Canada a la chance de pouvoir compter sur l'un des meilleurs systèmes de recherche documentaire du monde, soit l'Institut canadien de l'information scientifique et technique (ICIST), qui fait partie du Conseil national de recherches du Canada (CNRC).

Le CNRC possède les ressources nécessaires pour faire connaître la documentation disponible. Grâce à son Service d'information technique (SIT), il peut mettre à la disposition des chercheurs et des responsables de la commercialisation des renseignements sur les programmes qu'il réalise ou prévoit lancer. À l'heure actuelle, cette information n'est pas utilisée autant qu'elle devrait l'être. En règle générale, les chercheurs ne connaissent pas toute l'information disponible au sein des services de recherche gouvernementaux et des organismes dispensateurs de subventions.

Le CCI, par l'intermédiaire de ses associations constituantes, reconnaît l'utilité de fournir de l'information au secteur privé. Au mois de juin 1985, l'Ordre des ingénieurs du Québec, l'organisme chargé de la réglementation professionnelle des ingénieurs au Québec, a tenu une exposition d'une durée d'une semaine au complexe Desjardins, à Montréal. Cette exposition avait pour but de fournir à la population et aux utilisateurs des services de génie de l'information sur la profession. On estime à plus de 200 000 le nombre de personnes qui ont eu la chance de voir cette exposition.

RECOMMANDATIONS

Le CCI recommande que des liens beaucoup plus solides et étroits soient établis entre les syndicats, les universités, les industries et l'État. Il recommande en outre que les organismes gouvernementaux associés à la R-D soient dépolitisés et que les changements aux politiques soient progressifs, de façon à déranger le moins possible la planification industrielle.

Les organismes gouvernementaux devraient compter dans leurs rangs des personnes ayant l'expérience du secteur privé. Le programme de permutation des cadres devrait être maintenu et étendu aux secteurs industriel et universitaire.

Le CCI recommande que l'on sensibilise davantage le public à la science et à la technologie, au moyen de reportages dans les médias, de concours et de prix d'excellence, ainsi qu'en y accordant une plus haute priorité à tous les niveaux de l'administration gouvernementale.

Pour que la recherche et le développement puissent être orientés en fonction des besoins du marché, il faut que les chercheurs, les promoteurs et le secteur privé puissent compter sur une planification à long terme.

Le CCI recommande que l'Institut canadien de l'information scientifique et technique fasse l'objet d'une campagne de publicité visant à en faire connaître les services ainsi que leur coût. Cette campagne devrait avoir but de montrer aux professeurs de même qu'aux étudiants qui suivent des cours de science et de génie de quelle façon effectuer de la recherche documentaire en se servant des ressources de l'ICIST et des autres bibliothèques publiques et industrielles; de distribuer de l'information sur l'ICIST à toutes les entreprises et toutes les organisations pouvant s'intéresser à la R-D; de préparer des présentations en vue de conférences techniques, de façon à illustrer ou à montrer le processus de recherche documentaire et de concevoir des messages publicitaires sur l'ICIST pour la presse écrite et électronique.

Le CCI recommande que le Service d'information technique du CNRC soit annoncé, commercialisé et élargi, par le recours à des experts-conseils. Le SIT devrait lancer une campagne de publipostage à l'intention de toutes les entreprises et organisations pouvant s'intéresser à la R-D et installer des stands dotés de personnel compétent lors des diverses conférences tenues au Canada. Le CCI recommande qu'au lieu d'accroître le nombre de ses employés affectés au soutien et au service, le SIT confie une partie de son travail à des cabinets d'experts-conseils qui agiraient en étroite collaboration avec le personnel du SIT. Cette façon de procéder permettrait à du personnel qualifié de venir en aide au petit manufacturier au moyen d'échanges d'information simples et directs. Elle permettrait également aux cabinets canadiens d'experts-conseils de se faire des contacts utiles dans le secteur de la petite entreprise. Le SIT devrait également percevoir des frais pour certains de ses services, de façon à recouvrer une partie de ses coûts.

Le CCI recommande que le CRSNG ainsi que les autres organismes qui versent des subventions s'assurent que les chercheurs produisent des comptes rendus de leurs travaux, à savoir : résultats, répercussions pour l'industrie, applications possibles, méthodes de mise en oeuvre, marchés potentiels, perspectives de succès commercial et bibliographie.

Le CCI recommande que tous les organismes gouvernementaux responsables des programmes de subventions appliquées à la science exigent et financent la rédaction, au terme de chaque projet, d'un document succinct ou d'un résumé pouvant être publié dans des revues à caractère technique ou commercial. Le coût d'une telle politique serait minime et, dans de nombreux cas, celle-ci aurait pour effet de mettre à la disposition de l'industrie canadienne des renseignements qui autrement seraient perdus.

Le CCI recommande que de brèves nouvelles décrivant des projets de recherche appliquée prometteurs soient publiés dans des revues à caractère technique ou commercial. Il conviendrait en outre d'encourager les entreprises à faire connaître le fruit de leurs travaux de recherche et de développement, lorsqu'ils s'avèrent rentables commercialement.

COMPTE TENU DES FORCES DU MARCHÉ, DE L'IMPORTANCE DES "MASSES CRITIQUES" ET DE LA TENDANCE DES ENTREPRISES UTILISANT LES TECHNOLOGIES DE POINTE À SE REGROUPER EN NOYAUX - CE QUI PROVOQUE UN PHÉNOMÈNE DE CONCENTRATION - QUE DEVRAIENT FAIRE LE GOUVERNEMENT ET LES AUTRES SECTEURS POUR ASSURER UN ÉQUILIBRE ENTRE LES RÉGIONS?

Comme nous l'avons mentionné, les entreprises à vocation scientifique et technique doivent s'orienter en fonction des besoins du marché. Or, dans de nombreux cas, la commercialisation d'un produit exige que l'entreprise qui le fabrique soit située à proximité du marché visé. De plus, les entreprises à vocation scientifique et technique sont en général situées près des endroits où la recherche et le développement s'effectuent. Pour cette raison, les entreprises s'installent généralement près de centres universitaires prestigieux.

Malheureusement, un nombre considérables des programmes canadiens de science et de technologie ne sont pas axés sur les besoins du marché et leur soutien par l'État est très politisé. Par le passé, les élus se sont

servis de la science et de la technologie comme moyen de réaliser des promesses électorales dans leurs régions respectives. Les dirigeants politiques ont le pouvoir de déplacer les administrations et les ressources dans diverses parties du pays. Bien que l'opportunité de transférer des ministères dans des régions éloignées soit discutable, la réinstallation est généralement sans effet sur l'efficacité d'un ministère. Or on ne saurait en dire autant des industries à caractère scientifique et technique.

RECOMMANDATIONS

Le CCI recommande que les entreprises à vocation scientifique et technique soient orientées en fonction des besoins du marché, et que les entreprises fondées sur l'utilisation de la technologie soient regroupées par noyaux à proximité de centres universitaires prestigieux.

QUELLES MESURES FAUT-IL PRENDRE POUR AMÉLIORER LA COLLABORATION PATRONALE-SYNDICALE EN CE QUI CONCERNE L'IMPLANTATION DES TECHNOLOGIES NOUVELLES?

La compétitivité de l'industrie canadienne sur les marchés étrangers dépend de la collaboration des syndicats, pour assurer la productivité la plus élevée possible. Les technologies de pointe sont tributaires de l'efficacité de la main-d'oeuvre, qui comme toujours demeure un élément vital de l'industrie canadienne. C'est pourquoi la collaboration patronale-syndicale est indispensable à l'essor de la science et de la technologie au Canada. Les syndicats peuvent contribuer à la commercialisation des produits issus de l'application des technologies nouvelles en reconnaissant la nature de leur rôle de même qu'en assurant la productivité des travailleurs et la compétitivité des produits qu'ils fabriquent.

RECOMMANDATIONS

Le CCI recommande que les syndicats jouent un rôle important dans le processus décisionnel visant à assurer l'essor de la science et de la technologie. Ainsi, nous recommandons que les représentants du monde syndical jouent un rôle plus important dans le processus décisionnel en étant admis au conseil d'administration de divers organismes gouvernementaux et de sociétés d'État, tels le CN, l'Administration de la Voie maritime du Saint-Laurent et l'Énergie atomique du Canada Limitée.

Le CCI recommande que l'on examine les programmes de participation aux bénéfices comme moyen d'encourager les travailleurs à s'intéresser davantage à l'élaboration et à la commercialisation des nouveaux produits de la science et de la technologie et à assumer une partie des risques qui s'y rattachent.

FAIRE FONCTIONNER UNE STRATÉGIE NATIONALE EN MATIÈRE DE SCIENCE ET DE TECHNOLOGIE

QUELS SONT LES RÔLES RESPECTIFS DU GOUVERNEMENT FÉDÉRAL, DES GOUVERNEMENTS PROVINCIAUX, DES UNIVERSITÉS, DU SECTEUR PRIVÉ, DES SYNDICATS ET DE NOTRE ORGANISATION DANS L'ÉLABORATION ET LA MISE EN OEUVRE D'UNE POLITIQUE FRUCTUEUSE EN MATIÈRE DE SCIENCE ET DE TECHNOLOGIE?

Pour relever les défis et réaliser les possibilités que représentent la science et la technologie au Canada, il nous faut accroître notre capacité d'exploiter les ressources disponibles aujourd'hui et veiller à ce qu'elles soient adaptées et améliorées, en fonction des besoins futurs de notre pays.

Comme on a pu le constater, le CCI croit que le succès d'une politique nationale sur la science et la technologie dépend de trois conditions :

- Il faut que la recherche et le développement au Canada soient orientés en fonction des besoins du marché.

- Il faut prévoir de meilleurs incitations financières, qui soient fondées sur une exploitation commerciale fructueuse de la recherche et du développement. Les stimulants fiscaux doivent être maintenus et améliorés, pour que la technologie fasse l'objet d'investissements industriels.

- Il faut que le Canada se dote d'un mécanisme qui permette une diffusion adéquate de la technologie.

Les gouvernements fédéral et provinciaux de même que les administrations territoriales doivent se concerter afin que le secteur privé intensifie ses investissements, la R-D et l'innovation. Les actuelles ententes sur le développement économique et régional fournissent le cadre nécessaire à un effort fédéral-provincial de développement de la science et de la technologie. Malheureusement, le fait que notre pays soit une fédération entraîne des différences dans de nombreux domaines. Bien que l'éducation soit la responsabilité des provinces et que le pouvoir de décision en matière d'établissements d'enseignement leur appartienne, le gouvernement fédéral apporte une contribution significative à l'éducation, au moyen de paiements de transfert et de subventions de fonctionnement. La collaboration est donc de rigueur.

RECOMMANDATION

Le CCI recommande que les gouvernements fédéral et provinciaux de même que les universités, les syndicats et les milieux industriels collaborent davantage, afin de faciliter l'élaboration d'une politique canadienne sur la science et la technologie. Cette collaboration devra tenir compte des autres recommandations du CCI, à savoir : recherche et développement orientée en fonction des besoins du marché, stimulants fiscaux pour les industries et mise en place d'un mécanisme de diffusion de la technologie.

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The Humanities in Canada: Cooperative Strategies for a National Science and Technology Policy

A presentation to the Honourable Frank Oberle, P.C., M.P.
Minister of State for Science and Technology

and to

The Canadian Forum on a National Science and Technology Policy
Fort Garry Hotel, Winnipeg Manitoba
8-10 June 1986

The Humanities in Canada: Cooperative Strategies for a National Science and Technology Policy

Summary

I The Mandate, Rôle and Stance of the Federation

Founded in 1943 as the Humanities Research Council of Canada, the Canadian Federation for the Humanities (CFH) was incorporated under its present name in 1978. It is a non-profit organization composed of thirty learned societies, and individual and corresponding members from all Canadian universities: over 8,000 scholars, active in Canadian studies; languages and literatures; histories of science, medicine, technology and mathematics; philosophy; religion; history; theatre; music; archaeology; and classics.

The Federation assists in the development of research policies affecting the humanities; promotes exchanges among scholars through the coordination of the activities of its member societies; administers a programme of aid to scholarly publications; represents the interests of the humanities to the government and other public organizations; and interprets the humanities to the general public.

The nature of humanities research is primarily individual, although numerous scholars are also involved in large-scale team projects across Canada; through research and teaching, the results are an essential part of the culture and civilization of Canada. The CFH values its participation in the Forum as the sole organization charged with urging the importance of the humanities for national research and development activities. Representing the core disciplines of Canada's $6.1 billion university industry, and the principal teachers in our cultural industry — which alone exceeds agriculture in national economic importance — the humanities scholars nevertheless base their contributions to Canada on qualitative rather than quantitative arguments.

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II New Knowledge

1. As examples of the effects of university underfunding, CFH offers five areas of immediate concern:

   a) Language and cultural studies of our major trading partners, present and future, are in jeopardy. Japanese and Chinese are now scarcely taught in Canada; German was abolished in one Canadian university last year, as was Russian, on the grounds of economy. The problem is not confined to one region or area.

   b) Senior Canadian business leaders have increasingly been speaking out about their searches for new managers with the qualities of mind instilled by a humanities (not business administration) background. Yet humanities departments are the first to be cut back in the current EPF conundrum.

   c) Canada has an international reputation in branches of philosophy and theology which include biomedical ethics (when to end life) and biotechnological ethics (about the cloning of genes, disease and antibody organisms and human tissue). Philosophy and religious studies departments however, are regarded as soft in cut-back programmes.

   d) Primary and secondary school education to produce a new generation of scientifically literate Canadians depends on the basic skills of language, writing and analysis instilled by their teachers. Teacher training in the humanities disciplines is nevertheless being reduced.

   e) Interdisciplinary Canadian Studies programmes are major avenues for young Canadian students to become familiar with national perspectives in French and English. Cross-cultural

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bi- and multi-lingual courses, including native studies, not only sensitize students to the complexities of Canada. They also afford an introduction to wider views made necessary by international business and communications systems. Canada's excellence in bilingual computing, for instance, rests on basic humanities work in linguistics, terminology and translation. In the absence of directed funding, many universities regard Canadian Studies programmes as irrelevant frills.

2. For humanists, libraries are their laboratories. Underfunding has crippled all Canadian university libraries during the past decade, by radically reducing book and document purchases, and access to data banks. In English Canada only one university library aspires even to second-class importance, and none in Québec.

3. The unemployment and underemployment of highly qualified PhDs, particularly in the humanities, will result in a crisis in university staffing during the next ten years. The agonies of the 1960s appear about to be repeated. Despite its attempts to face this crisis, and the help of various Ministers, the Social Sciences and Humanities Research Council, with the other two federal granting councils, remains underfunded, both absolutely and comparatively.

III Realizing Opportunities

International development and economic cooperation obviously depends on Canadians' understanding of their target countries' cultures and languages, both at established S&D levels and with NICs. Conversely, if long-term intellectual amortization is in Canada's interests, foreign students and scholars brought here can best understand us through our own languages and culture. For both, the humanities are

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central, unless scientific exchanges are to result simply in exchange ghettoes. Without the systematic cultivation of knowledge both ways our scientific and technological transfers will inevitably suffer.

IV Adapting to Changes

All successful students of pure and applied science have been taught how to learn inventively, from primary school to post-doctoral studies: which is also the principal rôle of university teachers of the humanities, among others. Old nostrums about the humanities as the opiate of a new leisure society have proven absurd. Public awareness of the impact and implications of science and technology depends as much on literate scientists who can speak to their society as it does on a more scientifically literate society. Scientists as well as humanists have to recognize their mutual interdependence in devising creative methodologies and cooperative ventures; thinking acutely about the historical and philosophical contexts of their immediate research; mobilizing and establishing public support; and communicating effectively with their tax-paying supporters.

V A Working Strategy

All Canadian scientists have received part of their basic education in the humanities. Both scientists and humanists need to recognize the importance of their revived cooperation as a matter of public policy: at the higher levels of public awareness, social concerns, university staffing, primary and secondary education, and research funding.

To these ends the Canadian Federation for the Humanities suggests to the Forum that the Science Council of Canada and the Canadian Federation for the Humanities be granted funds to allow the commissioning of a study in depth of the intellectual and economic importance of the humanities in Canada to a national scientific and technological policy, with a view to enhancing mutual cooperation among the humanities and the pure and applied sciences.

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Les sciences humaines au Canada : Stratégies coopératives en vue d'une politique nationale des sciences et de la technologie

Présentation à l'honorable Frank Oberle, C.P., député
Ministre d'État chargé des sciences et de la technologie

et à la

Conférence nationale sur la politique scientifique et technologique
Hôtel Fort Garry, Winnipeg (Manitoba)
8-10 juin 1986

VEUILLEZ NOTER

Les études humaines au Canada : Stratégies coopératives en vue d'une politique nationale des sciences et de la technologie

Résumé

I Le mandat, le rôle et la position de la Fédération

Créé en 1943, le Conseil canadien des recherches sur les humanités a été incorporé en 1978 sous le nom de Fédération canadienne des études humaines (FCEH). Organisme à but non lucratif, celle-ci regroupe trente sociétés savantes ainsi que plus de 8 000 membres individuels ou correspondants de toutes les universités canadiennes, qui oeuvrent dans les domaines suivants : études canadiennes, langue et littérature, histoire de la science, de la médecine, de la technologie et des mathématiques, philosophie, religion, histoire, théâtre, musique, archéologie et études classiques.

La Fédération contribue à l'élaboration des lignes de conduite visant la recherche en sciences humaines; favorise les échanges entre les spécialistes en coordonnant les activités des sociétés membres; administre un programme d'aide à la publication d'ouvrages érudits; défend les intérêts du secteur des sciences humaines auprès du gouvernement et d'autres organismes publics; et fait office du vulgarisateur auprès du grand public.

En règle générale, les chercheurs en sciences humaines travaillent de façon individuelle, quoique plusieurs d'entre eux participent à des projets collectifs de grande envergure à l'échelle du Canada. Grâce à la recherche et à l'enseignement, ces travaux constituent un élément essentiel de la culture nationale. La FCEH estime très importante sa participation à cette conférence, étant la seule organisation chargée de faire valoir l'importance des sciences humaines dans les activités nationales de R-D. Les spécialistes en études humaines représentent les disciplines universitaires de base, un secteur d'activité de 1,6 milliard à l'échelle nationale, et regroupent les principaux enseignants de notre industrie culturelle, dont l'importance économique dépasse d'ailleurs celle de l'agriculture; cependant, ils évaluent leur contribution à la société canadienne en termes qualitatifs plutôt que quantitatifs.

II Nouvelles connaissances

1. Les cinq secteurs suivants offrent d'excellents exemples des effets du sous-financement des universités :

   a) La survie des programmes d'études axés sur la langue et la culture de nos principaux partenaires commerciaux, actuels et futurs, est menacée. On n'enseigne presque plus le japonais et le chinois au Canada; l'année dernière, l'allemand a été

aboli dans une université, comme le russe d'ailleurs, pour des raisons d'économie. Le problème n'est pas particulier à une région donnée.

b) De plus en plus, des hommes d'affaires canadiens éminents avouent avoir de la difficulté à trouver de jeunes gestionnaires possédant les qualités intellectuelles que procure une formation en sciences humaines, mais non des études en administration. Pourtant, les départements de sciences humaines sont les premiers à subir des coupures en vertu des mystérieuses mesures de Financement des programmes existants.

c) Le Canada jouit d'une réputation internationale dans certaines branches de la philosophie et de la théologie, notamment en ce qui a trait à l'éthique de la biomédecine (euthanasie) et de la biotechnologie (clonage génétique, maladies et anticorps, tissus organiques). Cependant, on considère comme bénignes les coupures qui touchent les départements d'études philosophiques et religieuses.

d) La capacité des écoles primaires et secondaires à produire une nouvelle génération de scientifiques canadiens dépend des aptitudes à s'exprimer, à écrire et à analyser que leur inculquent leurs professeurs. Pourtant, on diminue les ressources consacrées à la formation des enseignants en sciences humaines.

e) Les programmes d'études canadiennes interdisciplinaires sont une excellente façon pour les jeunes d'acquérir une perspective nationale et biculturelle. Non seulement les cours de culture et de langue, y compris les études autochtones, permettent-ils de sensibiliser les étudiants à la mosaique canadienne, mais ils leur apportent l'ouverture d'esprit rendue essentielle par l'internationalisation des affaires et des systèmes de télécommunications. Par exemple, l'excellence du Canada en informatique bilingue repose sur les travaux effectués dans les secteurs de la linguistique, de la terminologie et de la traduction. Mais en l'absence d'un programme de financement particulier, nombre d'universités considèrent les études canadiennes comme superflues.

2. Les bibliothèques sont les laboratoires des spécialistes en sciences humaines. Au cours des dix dernières années, toutes les bibliothèques universitaires canadiennes ont souffert du sous-financement, qui les a forcées à diminuer radicalement leurs achats de livres et de documents, et a restreint leur accès aux banques de données. La plus importante bibliothèque universitaire du Canada anglais n'est qu'une bibliothèque de seconde classe, et aucune au Québec n'atteint même ce niveau.

3. Le chômage et le sous-emploi chez les titulaires de doctorats, notamment en sciences humaines, entraînera une véritable crise de l'embauche au sein des universités au cours des dix prochaines années. C'est un retour aux années 60. Malgré ses efforts pour trouver une solution au problème, et malgré l'aide accordée par plusieurs ministres, le Conseil de recherches en sciences humaines du Canada, tout comme les deux autres conseils de subventions fédéraux, souffre toujours d'un financement insuffisant.

III <u>Saisir les possibilités</u>

Le développement international et la coopération économique supposent de toute évidence que les Canadiens connaissent la culture et la langue des pays visés, qu'il s'agisse des niveaux établis d'étude-développement ou des pays nouvellement industrialisés (PNI). De même, si l'amortissement " intellectuel " à long terme sert les intérêts du Canada, c'est par le biais de nos langues et de notre culture que les étudiants et les chercheurs étrangers apprendront à mieux nous connaître. Dans les deux cas, les sciences humaines jouent un rôle de premier plan, à moins que les échanges scientifiques ne s'effectuent en vase clos. L'échange systématique de connaissances est essentiel aux transferts scientifiques et technologiques.

IV S'adapter au changement

Les étudiants qui ont réussi en sciences pures et appliquées le doivent au fait qu'on leur a appris à développer leur esprit créateur, et ce de l'école primaire jusqu'aux études post-doctorales; c'est d'ailleurs l'un des rôles principaux (mais non exclusif) des professeurs de sciences humaines. Le vieux préjugé voulant que celles-ci soient l'opium de la nouvelle société des loisirs n'ont heureusement plus cours aujourd'hui. La sensibilisation du public aux effets de la science et de la technologie repose autant sur l'existence de scientifiques habiles à communiquer que sur le niveau de connaissances de la société en ces matières. Les scientifiques et les spécialistes des sciences humaines doivent reconnaître leur dépendance réciproque en ce qui a trait à la conception de méthodologies novatrices; à la mise sur pied d'initiatives communes; à la compréhension du contexte historique et philosophique dans lequel s'inscrit leur recherche actuelle; à la mobilisation du soutien public; et à une communication fructueuse avec les contribuables.

V Une stratégie de travail

Tous les scientifiques canadiens ont reçu une certaine formation de base en sciences humaines. Ils doivent reconnaître l'importance de participer activement, de concert avec les spécialistes des sciences humaines, à l'élaboration de la politique touchant la sensibilisation

du public, les questions d'ordre social, la dotation des universités, l'enseignement primaire et secondaire, et le financement de la recherche.

Conséquemment, la Fédération canadienne des études humaines suggère que lui soient accordés, ainsi qu'au Conseil des sciences du Canada, des crédits pour la réalisation d'une étude approfondie sur l'importance intellectuelle et économique des sciences humaines dans le cadre d'une politique nationale des sciences et de la technologie, dans le but notamment de favoriser une collaboration accrue entre le secteur des sciences humaines et celui des sciences pures et appliquées.

CANADIAN FEDERATION OF BIOLOGICAL SOCIETIES

FEDERATION CANADIENNE DES SOCIETES DE BIOLOGIE

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The Elaboration of a National Science and Technology Policy: the Participation of Biological and Medical Researchers

Summary of the Brief submitted by

The Canadian Federation of Biological Societies

to

The Minister of State for Science and Technology

at the

CANADIAN FORUM ON A NATIONAL SCIENCE AND TECHNOLOGY POLICY

Winnipeg, June 8-10. 1986

575 King Edward, OTTAWA, Ontario Canada K1N 7N5 Tel.: (613) 234-9555

The Canadian Federation of Biological Societies (CFBS) welcomes the joint initiative of federal, provincial and territorial ministers of science and technology to hold a "Canadian Forum on a National Science and Technology Policy". We are grateful to be offered the opportunity to take part in such a timely event for the future of our Country.

CFBS is a federation of nine learned societies and represents near 4 000 biological and medical researchers working in the private sector, government laboratories and universities across Canada. The majority of our members are constituents of the Medical Research Council (MRC) and the Natural Sciences and Engineering Research Council (NSERC). Member societies of CFBS are:

- Canadian Physiological Society
- Pharmacological Society of Canada
- Canadian Association of Anatomists
- Canadian Biochemical Society
- Canadian Society for Nutritional Sciences
- Canadian Society for Cell Biology
- Canadian Society for Immunology
- Society of Toxicology of Canada
- Biophysical Society of Canada

Question 1 a: Is Canada getting maximum benefits from money spent on university research? If not, what steps should be taken to improve the situation?

No, because of the underfunding of universities by the provinces. Research grants must now cover far more expenses than they used to. Faculty members have less time to spend on research because of increased teaching requirements (more students, fewer faculty).

The federal government must find some way of getting money into the universities at least to support the indirect costs of research, and must demand a certain percentage of faculty time for research, if they are to receive grant support. All basic research is now to be carried out in university laboratories, given the emphasis in government laboratories on industrial support and technology transfer (eg. NRC). Therefore, it is more important than ever that the federal government support our universities. Since basic research is, and should be, a federal priority, we cannot afford, as a nation, to leave that responsibility to the provinces.

RECOMMENDATION 1:

In order to prevent further degradation in the universities ability to support the basic research (that is essential to generate applicable knowledge), the federal government should not proceed with its proposed modification to the EPF (Bill C-96). Rather, there should be a First Ministers' meeting called to discuss solely the state of higher education in Canada.

This conference would discuss and hopefully implement the proposals put forward during the forum to improve the state of the universities, including their ability to support research and development.

Question 1b: If new money were to become available, should it be used for university research and, if so, how should it be spent to assure maximum benefit to the Country?

All new money which is to become available for basic research (our life blood in coming years, without it there will be no technology to transfer obviously) must go to the universities since neither government nor industry is involved in basic research according to MOSST's background document. Money for basic research, by the very nature of science, cannot be directed.

RECOMMENDATION 2 (i) and (ii):

In order to ensure that research infrastructure in Canada can plan its research efforts and achieve them in the most productive way, we recommend that:

(i) the federal government be urged to endorse the objectives of the Five-Year Plans of the granting agencies as submitted in the Fall 1985 and,

(ii) the new base budget of the granting councils be indexed for inflation, using the present fiscal year;

This modification to the proposed budget over the next five years is a modest proposal that we consider minimal, though essential, to maintain the high quality of research presently done in Canada and to optimize the chances of successs of the new Matching Programme.

Question 1 c: How can we encourage better linkage between the private sector and universities?

(i) The universities are now reaching out to industry with more than an open hand (looking for donations as in the past). There is a role for the type of research park many universities are developing. Industry is not likely to support truely basic research because of the lack of guaranteed short-term gain. The federal government might be able the help (eg. financially) in developing research parks.

(ii) In a trial to define the parameters of a Matching Programme acceptable to the granting councils, the institutions and the private sector, CFBS would like to recommend the following scheme to the Forum:

RECOMMENDATION 3:

In order to optimize the efficiency of the Matching Programme (i.e. attract new money from private sector quickly, maximize the fraction of the matched money being given to the granting councils and minimize the operating costs), the Government should build on existing arrangement among the institutions, the granting councils and the private sector, in the following way:

1. The private investor that does qualify for the Matching Programme should receive an attractive incentive in terms of tax credits, after he paid the full costs of the research contract, as it is the case now, to the university.

2. The institution or the investigaor who did recruit the private investor's contract or donation would submit an application for the Matching Programme to the pertinent council,

and accordingly receive 15% of the matching fund attached to this specific research contract or donation. In the case of a research contract, this would be a net incentive of 15%, since there are provisions covering overhead cost in the actual research contract. We believe that such a figure (15%) is sufficient to act as an incentive to the investigator-university system, and small enough to prevent the private investor to "level down" or invest less for the same pay-off.

3. After ensuring that the eligilibity criteria are met by applicants, the Granting Councils would submit the application to the Government. The matching funds would then flow, to be partitioned two ways: at least 85% would go directly to the relevant granting council to support its base programs; the remaining portion (up to 15%) would go directly to the recruiting individual or the institution for the support of eligible research in any area of endeavour.

4. As far as the eligibility criteria are concerned:

a) Donations from private sector as well as research contracts should be eligible to the Matching Programme;

b) The eligible research should be defined to include all activites considered as research and scholarship by universities and the granting council. We would like to suggest the following definition which encompasses both basic and applied research as well as development:

> "Research and development is exploratory and innovative work undertaken on a systematic basis towards the acquisition of new knowledge in new ways. New knowledge involves the integration of newly acquired information into existing hypothesis, the formulation and testing of new hypothesis or the re-evaluation of existing observations."

(iii) Improving communication between university and corporate researchers is an important step in facilitating collaborative projects. A means of promoting interchange as well as providing a mechanism for directly facilitating cooperative research would be the co-sponsorships of post-doctoral fellows by a university and a corporation. Such arrangements could also enhance the subsequent employment prospects of such fellows.

(iv) Finally, we believe that increased corporate R & D will only come out of increased corporate R & D spending in general (i.e. it will not supplant current in-house corporate R & D) regardless of what happens in government R & D. Unfortunately, there are major barriers to this increased R & D in general.

These barriers are a function of the nature of the Canadian political and economic system which is resource and branch-plant oriented in many aspects. In our own field, we cannot see any increase in innovative pharmaceutical R & D (or related emerging biotechnology) occurring until there is patent protection of intellectual property (as it applies to medicines and foods) to something approaching the levels provided in other developed countries.

Moreover, on a short and mid-term basis, we believe that pharmaceutical industry is the only realistic source of private sector contribution that will allow the Medical Research Council to reach the matching fund levels ($111 million) it desperately needs to maintain its 1985-86 purchasing power over the next five years, along with the Federal Five-Year Funding Plan recently adopted. Patent Act is the cornerstone of pharmaceutical research done in Canada:

RECOMMENDATION 4:

In order to ensure that (i) Canadians obtain the benefits of increased indigenous research and industrial development, and that (ii) drug prices do not rise beyond average world level, it is recommended that Federal Governement be urged to table concrete measures that will link the extended patent protection to the amount spent by the pharmaceutical companies on research done in Canada and to drug prices.

Question 3: How could Canada realize more benefits from international science and technology developments?

Canada will realize benefits in proportion to its contributions to international science. If basic scientists have something to say they get invited to international meetings. CFBS holds an Annual Scientific Conference, the only one of its kind in Canada, which encompasses all areas of biological research. Over the past decade, scientists of international renown have been deliberately invited to participate in our meetings.

Question 4: Should Canada target its science and technology resources in a range of strategic areas so as to maximize return?

No. This is very dangerous for basic research. If some areas are to be completely cut off, it is probably also not a good idea for applied research. Who decides how to target(or what)?

Question 9: What can be done to promote greater public awareness of, and participation in, the issues of science and technology?

We agree that more emphasis must be put on "public awareness of science". Over the past four years, CFBS organized Public Awareness Sessions during its annual meeting. This year in Guelph, two sessions have been organized: one on "The need for Animal Use in Research", and a second one on the "Ethics and Morality of Biotechnology- the Rights and Wrongs". Moreover, CFBS in collaboration with the Canadians for Health Research (CHR) obtained a grant from the "Public Awareness Program for Science and Technology" that is administered by the Department of Supply and Services. Funds have been received in 1985 to collect the information necessary to produce an inexpensive non-technical paperback for the general public which will: describe how individual research studies contributed to recent clinical advances in the diagnosis and treatment of five neurological disorders; document the significant role of Canadian scientist have played in these advances; and, profile a few of the Canadian scientists whose research contributed in a major way to these advances. The publication of the paperback is now pending upon the acceptance of our 1986 application, that has been jeopardized by the $400 000 cutbacks to the program done this year.

Question 12: What are the respective roles of the federal government, universities, private sector and our organization in the development and implementation of a National Science and Technology Policy?

Major role is for federal government: both development and financial implementation. The role of an organization like ours is the actual implementation in the laboratory. The universities are crucial to maintain the research foundation and to produce highly qualified personel to carry out the policy. Canadian business must become more entrepreneurial; if they do not gain ground, they will lose it.

La Fédération canadienne des sociétés de biologie (FCSB) applaudit à l'initiative commune des ministres fédéral, provinciaux et territoriaux chargés des sciences et de la technologie de tenir une " Conférence nationale sur la politique scientifique et technologique ". Nous sommes très heureux d'avoir l'occasion de participer à cette rencontre d'une importance capitale pour l'avenir de notre pays.

La FCSB regroupe neuf sociétés savantes et représente quelque 4 000 chercheurs en biologie et en médecine oeuvrant dans le secteur privé, les laboratoires d'État et les universités. La majorité de nos membres adhèrent également au Conseil des recherches médicales (CRM) et au Conseil de recherches en sciences naturelles et en génie (CRSNG). La FCSB est le porte-parole des sociétés suivantes :

- La Société canadienne de physiologie
- Société pharmacologique du Canada
- Association canadienne des anatomistes
- La Société canadienne de biochimie
- La Société canadienne des sciences de la nutrition
- Société canadienne de biologie cellulaire
- Société canadienne d'immunologie
- Société de toxicologie du Canada
- Société biophysique du Canada

Question 1 a : Le Canada retire-t-il le maximum d'avantages des fonds consacrés à la recherche universitaire ? Dans la négative, quelles mesures pourrait-on prendre pour améliorer la situation ?

Non, car les crédits accordés aux universités par les provinces sont nettement insuffisants. En plus des coûts directs de la recherche, les subventions doivent maintenant couvrir une foule de dépenses connexes. Par ailleurs, étant donné l'accroissement de leur charge de travail (plus d'étudiants, moins de professeurs), les professeurs d'université ont moins de temps à consacrer à la recherche.

Le gouvernement fédéral doit trouver le moyen de fournir suffisamment de crédits aux universités pour couvrir à tout le moins les coûts indirects de la recherche, et poser comme condition à l'octroi d'une subvention que le corps enseignant consacre un minimum d'heures à cette activité. Comme les laboratoires gouvernementaux se consacrent principalement à l'aide au développement industriel et au transfert de la technologie (par exemple, le CNR), c'est aux universités qu'incombera désormais la recherche fondamentale. Il est donc plus que jamais essentiel que le gouvernement fédéral soutienne financièrement les maisons d'enseignement supérieur. La recherche fondamentale est, et doit demeurer, une priorité fédérale; nous ne pouvons nous permettre de confier cette responsabilité aux provinces.

RECOMMANDATION 1 :

Afin d'empêcher que ne se dégrade davantage la capacité des universités d'effectuer de la recherche fondamentale (laquelle est indispensable à l'acquisition de connaissances applicables), le gouvernement fédéral devrait renoncer à son projet d'amendement visant le Financement des programmes existants (projet de loi C-96). Il devrait plutôt convoquer une conférence des premiers ministres ayant pour seul thème l'état de l'enseignement supérieur au Canada.

Cette rencontre permettrait d'examiner et, espérons-le, d'adopter les propositions mises de l'avant lors de la Conférence et visant à améliorer la situation des universités, notamment quant à leur capacité de mener des travaux de R-D.

Question 1 b : Si de nouveaux fonds devenaient disponibles, devraient-ils être utilisés pour la recherche universitaire ? Dans l'affirmative, de quelle façon devraient-ils être dépensés pour offrir le maximum d'avantages au pays ?

Selon le document de travail du MEST, ni le gouvernement ni le secteur privé ne participent à la recherche fondamentale. Étant donné l'importance capitale de cette activité (sans laquelle il n'y aurait aucune technologie à transférer), il est donc essentiel que tous les crédits dégagés à cette fin soient accordés aux universités. La nature même de la science interdit la " réglementation " des crédits affectés à la recherche fondamentale.

RECOMMANDATION 2 (i) et (ii) :

Afin de permettre aux établissements de recherche canadiens de mieux planifier leurs efforts et de mener à bien leurs travaux de la façon la plus productive, nous recommandons :

(i) que le gouvernement fédéral fasse siens les objectifs définis dans les plans quinquennaux des organismes de subventions tels que présentés à l'automne 1985;

(ii) que le budget de base des conseils de subventions soit indexé sur le taux d'inflation, le présent exercice financier servant d'étalon.

A notre avis, cette modeste modification au budget des cinq prochaines années est une condition minimale, mais néanmoins essentielle, pour maintenir la qualité supérieure de la recherche présentement effectuée au Canada et pour multiplier les chances de succès du nouveau Programme jumelé.

Question 1 c : Comment pouvons-nous favoriser l'établissement de meilleurs liens entre le secteur privé et les universités ?

(i) Les universités ne se tournent plus vers le secteur privé uniquement pour solliciter des dons. Les centres de recherche spécialisés que plusieurs universités sont à mettre sur pied ont sans conteste un rôle à jouer. Mais l'industrie est peu encline à accorder son appui à la recherche fondamentale, celle-ci n'offrant aucune garantie de rentabilité à court terme. Le gouvernement fédéral pourrait contribuer (entre autres financièrement) au développement des centres de recherche spécialisés.

(ii) Dans un effort pour définir les paramètres d'un Programme jumelé acceptable aux conseils de subventions, aux établissements de recherche et au secteur privé, la FCSB entend proposer le régime suivant lors de la Conférence :

RECOMMANDATION 3 :

Afin d'assurer l'efficacité optimale du Programme jumelé (c'est-à-dire attirer rapidement de nouveaux capitaux privés, maximiser le pourcentage de crédits affectés aux conseils de subventions et minimiser les coûts d'exploitation), le gouvernement devrait faire fond sur les ententes liant les établissements, les conseils de subventions et le secteur privé, et ce de la manière suivante :

1. L'investisseur privé admissible au Programme devrait se voir accorder des crédits d'impôt attrayants dont il bénéficierait après avoir versé à l'université le montant total du contrat de recherche.

2. L'établissement ou le chercheur qui obtient un contrat ou un don d'un investisseur privé déposerait une demande d'admissibilité au Programme jumelé auprès du conseil intéressé, et se verrait ainsi accorder 15 p. 100 des crédits. Dans le cas d'un contrat de recherche, il s'agirait d'un stimulant net de 15 p. 100, puisque le contrat comporte des dispositions visant les frais généraux. A notre avis, ce pourcentage est suffisamment élevé pour stimuler le système chercheur-université, et suffisamment faible pour empêcher l'investisseur de réduire sa participation pour une compensation égale.

3. S'étant assurés que les requérants satisfont aux critères d'admissibilité, les conseils de subventions présenteraient la demande au gouvernement. Les subventions parallèles seraient alors réparties comme suit : un minimum de 85 p. 100 serait accordé directement au conseil intéressé pour le financement de ses programmes de base; et un maximum de 15 p. 100 serait versé au particulier ou à l'établissement pour le financement de travaux de recherche dans un secteur donné.

4. En ce qui concerne les critères d'admissibilité :

a) Les dons provenant du secteur privé de même que les contrats de recherche devraient être admissibles au Programme jumelé.

b) Les travaux de recherche admissibles devraient être définis de façon à inclure toutes les activités considérées comme faisant partie intégrante de la recherche ou des études par les universités et le conseil de subventions. Nous suggérons la définition suivante qui englobe tant la recherche fondamentale et appliquée que le développement :

" La recherche-développement est un travail d'exploration et d'innovation effectué de façon systématique dans le but d'acquérir de nouvelles connaissances. Cela exige l'intégration de nouvelles données à des hypothèses existantes, la formulation et la mise à l'épreuve de nouvelles hypothèses ou la réévaluation de données existantes. "

(iii) Une meilleure communication entre les chercheurs universitaires et ceux du secteur privé favoriserait grandement la mise en oeuvre de projets conjoints. Le co-parrainage des bourses post-doctorales par une université et une entreprise privée serait non seulement un excellent moyen d'encourager l'échange, mais également un mécanisme efficace pour faciliter la recherche conjointe. De tels arrangements pourraient en outre accroître les possibilités d'emploi de ces boursiers.

(iv) Enfin, nous sommes d'avis que seul un accroissement des fonds consacrés à la R-D par l'ensemble du secteur privé pourra stimuler la R-D industrielle, et ce indépendamment de la R-D effectuée au sein du secteur public. Malheureusement, trois obstacles majeurs s'opposent à la multiplication des travaux de ce type. Ces obstacles découlent de la nature même du système politique et économique canadien qui, à bien des égards, repose sur l'exploitation et la transformation des matières premières. En ce qui nous concerne, la R-D en pharmacologie (ou dans le nouveau secteur connexe de la biotechnologie) ne pourra se développer que si la protection en matière de propriété intellectuelle (en ce qu'elle s'applique aux médicaments et aux aliments) se rapproche de celle accordée dans d'autres pays industrialisés.

En outre, à court et à moyen termes, l'industrie pharmaceutique nous apparaît comme la seule source sûre de financement qui permettra au Conseil de recherches médicales d'obtenir les subventions jumelées (111 millions de dollars) essentielles au maintien de son pouvoir d'achat de 1985-1986 au cours des cinq prochaines années, en conjonction avec le plan quinquennal de financement récemment adopté par le gouvernement fédéral. La Loi sur les brevets est la pierre angulaire de la recherche en pharmacologie au Canada.

RECOMMANDATION 4 :

Afin d'assurer que (i) les Canadiens profiteront d'un accroissement de la R-D industrielle effectuée au pays, et que (ii) le prix des médicaments ne dépassera pas la moyenne internationale, nous recommandons que le gouvernement fédéral adopte des mesures concrètes afin de lier la protection accrue en matière de brevets aux crédits affectés par les fabricants de produits pharmaceutiques à la recherche effectuée au Canada, ainsi qu'aux prix des médicaments.

<u>Question 3</u> : Comment le Canada pourrait-il retirer plus d'avantages des progrès accomplis à l'échelle internationale dans le domaine des sciences et de la technologie ?

Les bénéfices du Canada seront proportionnels à son apport à la recherche scientifique mondiale. Pour être invités à des colloques internationaux, les chercheurs doivent avoir quelque chose à dire. La FCSB tient annuellement une conférence scientifique, la seule en son genre au Canada, qui couvre tous les secteurs de la recherche biologique. Au cours des dix dernières années, nous avons pris soin d'y inviter des scientifiques de renommée internationale.

<u>Question 4</u> : Le Canada devrait-il concentrer ses ressources scientifiques et technologiques dans certains secteurs stratégiques de façon à maximiser le rendement ?

Non. La recherche fondamentale s'en trouverait dangereusement compromise. Et si certains secteurs doivent être complètement délaissés, la recherche appliquée en souffrira également. Qui déciderait des secteurs à privilégier ?

<u>Question 9</u> : Que pouvons-nous faire pour sensibiliser davantage le public à l'égard des sciences et de la technologie et pour susciter sa participation dans ce domaine ?

Nous sommes d'accord pour que soient multipliés les efforts en vue de " sensibiliser le public à la science ". Depuis quatre ans, la FCSB tient des séances de sensibilisation lors de son assemblée annuelle. Cette année, à Guelph, deux séances ont été organisées : l'une sur " Les animaux, un complément essentiel à la recherche ", l'autre sur " L'éthique de la biotechnologie ". En outre, la FCSB, de concert avec les Canadiens pour la recherche médicale, s'est vu accorder une subvention dans le cadre du <u>Programme de sensibilisation du public canadien aux sciences et à la technologie</u>, administré par le ministère des Approvisionnements et Services. Les fonds que nous avons obtenus en 1985 étaient destinés à recueillir les données nécessaires à la rédaction d'un ouvrage de vulgarisation qui sera publié en édition de poche. Le grand public y trouvera des renseignements sur les travaux qui ont contribué aux progrès dans le diagnostic et le traitement de cinq troubles neurologiques, et sur l'apport important des scientifiques canadiens dans ce dossier; on y trouvera également un portrait de quelques-uns des chercheurs qui ont joué un rôle de premier plan à cet égard. La publication de cet ouvrage ne dépend

plus maintenant que de l'acceptation de notre demande de 1986, laquelle est d'autant plus aléatoire que le budget du programme a été amputé de 400 000 $ cette année.

Question 12 : Quels sont les rôles respectifs du gouvernement fédéral, des universités, du secteur privé et de notre organisation dans le développement et la mise en oeuvre d'une politique nationale des sciences et de la technologie ?

Le gouvernement fédéral joue manifestement un rôle de premier plan, tant au chapitre de l'élaboration de la politique que de sa mise en oeuvre. Le rôle d'une organisation telle que la nôtre est d'appliquer concrètement cette politique dans les laboratoires. Les universités remplissent deux fonctions essentielles : maintenir les assises de la recherche et former le personnel hautement qualifié chargé de la mise en oeuvre de la politique. Le secteur privé, quant à lui, doit accroître son esprit d'entreprise; s'il ne gagne pas du terrain, il en perdra inévitablement.

CANADIAN FEDERATION
OF
BIOLOGICAL SOCIETIES

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FEDERATION CANADIENNE
DES
SOCIETES DE BIOLOGIE

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Brief submitted by
The Canadian Federation of Biological Societies
to
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at the
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Winnipeg, June 8-10, 1986

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B. Joint Position Paper of PSC and CFBS on the Report of the Commission of Inquiry of the Pharmaceutical Industry (Eastman Commission)

C. Correspondence: -Hon. Michel Côté, Minister of Consumer and Corporate Affairs

-Hon. Jake Epp, Minister of National Health and Welfare

-Hon. Frank Oberle, Minister of State Science and Technology

D."Biological Researchers urge amendments to Patent Act" (News Release, March 4, 1986)

The Canadian Federation of Biological Societies (CFBS) welcome the joint initiative of federal, provincial and territorial ministers of science and technology to hold a "Canadian Forum on a National Science and Technology Policy". We are grateful to be offered the opportunity to take part in such a timely event for the future of our Country.

CFBS is a federation of nine learned societies and represents near 4 000 biological and medical researchers working in the private sector, government laboratories and universities across Canada. The majority of our members are constituents of the Medical Research Council (MRC) and the Natural Sciences and Engineering Research Council (NSERC). Member societies of CFBS are:

- Canadian Physiological Society
- Pharmacological Society of Canada
- Canadian Association of Anatomists
- Canadian Biochemical Society
- Canadian Society for Nutritional Sciences
- Canadian Society for Cell Biology
- Canadian Society for Immunology
- Society of Toxicology of Canada
- Biophysical Society of Canada

1. Developing and Acquiring New Knowledge:
Measures to be taken to strenghten the Scientific and Technological research base in Canada's higher education sector.

A. The Indirect Costs of Research

CFBS fully supports the views expressed by the President of Northern Telecom Ltd, D vid G. Vice, that "University laboratories can and should be leaders in the area of basic research and that still more significantly, post-secondary institutions remain our prime source of the trained personnel needed by a dynamic society". (Building on our Strenghts, MOSST, April 22, 1986, p. 10). Moreover, George Keyworth, Ronald Reagan's scientific advisor, stated at the 1984 Canada Tomorrow Conference (Ottawa) that no other research institution was as productive as the universities: they produce both new knowledge and the specialists via research activities. Nonetheless, the university sector is the sector which has received the lowest federal R & D funding between 1979 and 1985 (NSERC, 1985).

Moreover, although the direct costs of research are funded through the granting councils, in excess of 40% of the costs of research are covered by the universities themselves out of general operating revenues. These are the so-called "indirect costs of research" such as space, utilities and salaries.

The core support of universities is supplied by the provincial governments; however, the provinces are greatly aided by the federal transfers under the Established Programs Financing Act (EPF). The federal government has announced a unilateral cut to EPF amounting to a cumulative total of $5.5 billion by 1990. As a result of successive cutbacks by the provincial and federal governments, the Canadian university system is on the brink of disaster:

- since 1977-78, full-time equivalent enrolment in Canadian universities has increased by 24% while real expenditures per students in constant dollars have decreased by 18%.
- According to the Honourable Tom Siddon (then Minister of State for Science and Technology), "Canadian universities are operating with roughly half the resources per student of world-class American and European universities. This threat could seriously erode our university R & D effort, thereby reducing the quantity and quality of specialized human resources". (Science, Technology and Economic Development, 1985)

Our Federation is fearful that the actions of the federal government will lead the provinces to further retrenchment of their support to the universities and would like to make the following recommendation:

RECOMMENDATION

In order to prevent further degradation in the universities' ability to support the basic and applied research, it is recommended that the federal government should not proceed with its proposed modification to the EPF (Bill C-96). Rather, there should be a First Ministers' meeting called to discuss solely the state of higher education in Canada. This conference would discuss the various proposals that have been put forward during the forum to improve the state of the universities, including their ability to support research and development.

B. The Direct Costs of Research

In Canada, the direct costs of university research are almost entirely carried by the three federal granting councils, corporate support of university R & D in Canada representing only 2% of total corporate spending on R & D, and less than 1% of total university expenditures (Building on our Strenghts, MOSST, April 22, 1986, p. 11). Moreover, according to a survey by the Conference Board of Canada, the rate of increase for corporate spending on research and development is expected to slip in 1986, compared with the past two years (Research and Development in the Canadian Corporate Sector, Canadian Board of Canada, Feb. 1986, p. 4-5). CFBS is strongly in favor of an increased contribution of the corporate sector not only to university R & D, but also to intramural research done in Canada by the corporate sector. Concrete suggestion to achieve the mid and long-term goal are detailed below. However, it would be both utopic and catastrophic for the university-based research, and for the future of our Country, to place unrealistic hopes on the corporate sector's capacity to take over, on a short-term basis, a significant part of the federal government's responsibility as major funder of R & D in Canada, through the granting councils.

The financial plan announced by the federal government last February has some positive features but also has very serious shortcomings. On the positive side, the Federal Government has committed 5 years equivalent to the total budget given in 1985-86, that is $161.4 million for MRC and $311.6 million for NSERC. In addition, a 4% budgetary increase for fiscal year 1986-87, recently announced for both councils, turned out to be effectively a 2% increase for MRC, after Health and Welfare decided to apply the 2% cut across the board, MRC as well, and 2.8% increase for NSERC, after MOSST imposed a $3.6 million frozen allotment to pay for a program originally supported by the Canadian Forestry Services.

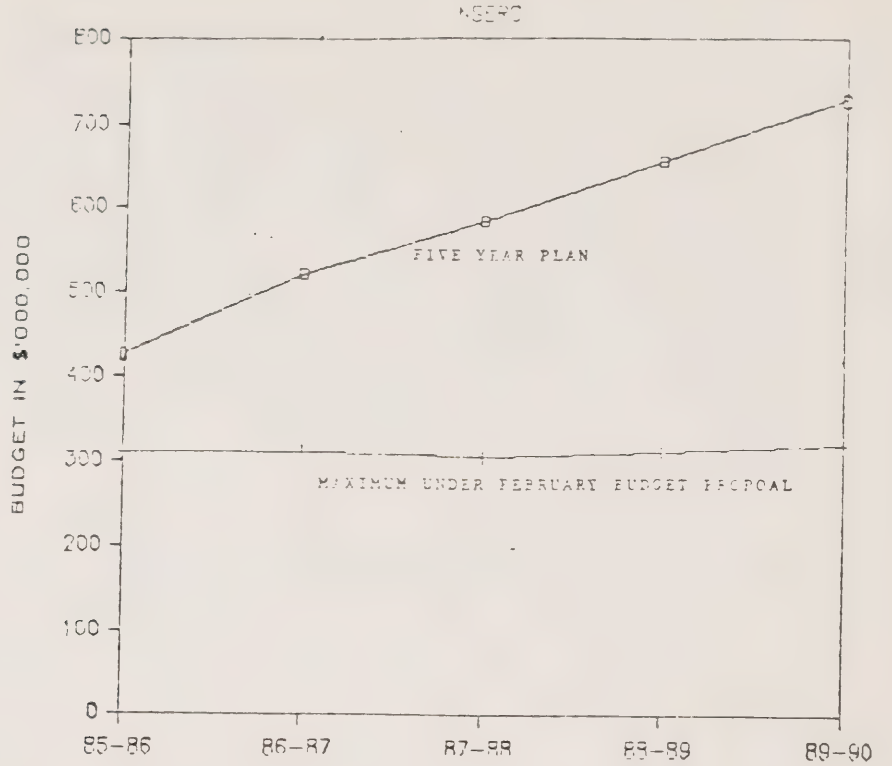
Our major reservations about this financial plan are based on the following facts. Since the monetary amounts in the plan are expressed in current dollars, no provision has been made for inflationary costs which can be expected to run at about 4% per year. In fact, this is an underestimation of the decrease in purchasing power of the scientists, since it does not account for the fact that most scientific apparatus are bought from the United States, and the CPI index does not account for the devaluation of the Canadian dollar relative to the American dollar. A realistic index would be

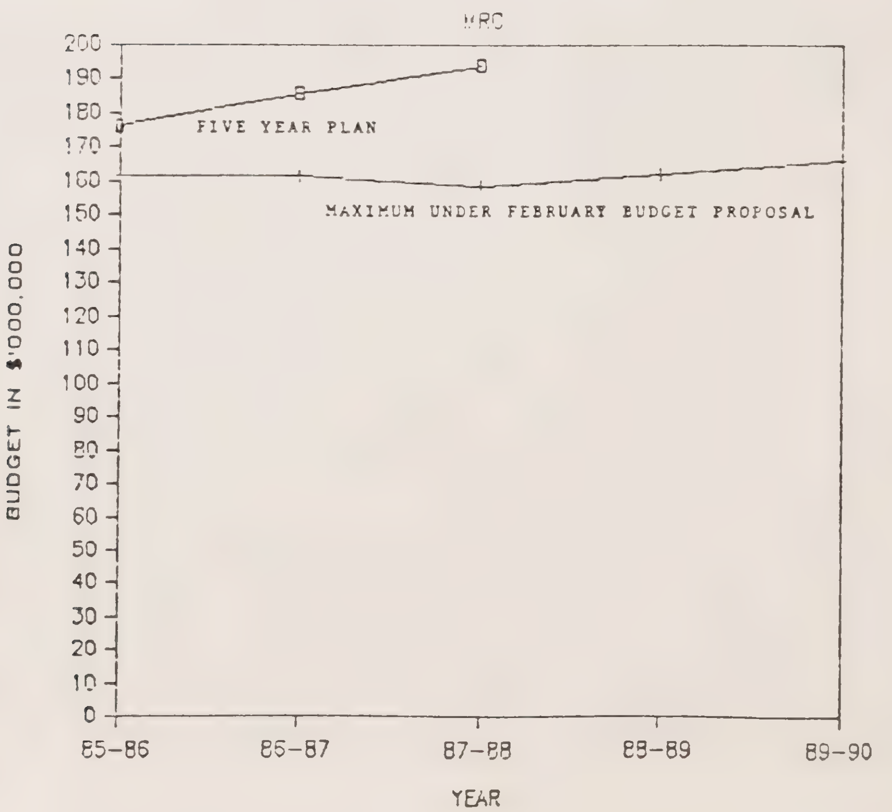
Finally, the actual funding plan allows for growth only through federal matching of private sector contributions. Although these contributions might be up to 6% of the budget of the previous year, there is no assurance that this money will be available. It is impossible for the granting councils to plan their operations which must extend over a number of years to support meaningful research on such a soft money budget.

CFBS is extremely disappointed that the realistic Five-Year Plans, carefully developed by each granting council have been apparently shelved by the Government. The unanimous support granted by the scientific community to the Five-Year Plans and the remarkable performance of the research councils with regard to both the management of public funds and the high quality of research carried out under their supervision were and still are our best guarantees that government investment in R & D is a calculated risk that must be planned, at least five years ahead, so that we don't lost track of our national R & D objectives.

The figures shown below compare NSERC and MRC budgets as proposed in their respective Five-Year Plan with the maximum funding under February 86 budget proposals. The private sector contribution has not been included, since this money will not be available to the councils to support their respective base programs.

5-YEAR PLAN VERSUS FEB. 86 BUDGET





RECOMMENDATIONS

In order to ensure that research infrastructure in Canada can plan its research efforts and achieve them in the most productive way, we recommend that:

(i) the federal government be urged to endorse the objectives of the Five-Year Plans of NSERC and MRC as submitted last fall, and,

(ii) the base budget of the granting councils be indexed for inflation, using the present fiscal year;

This modification to the proposed budget over the next five years is a modest proposal that we consider minimal, though essential, to maintain the high quality of research presently done in Canada, and to optimize the chances of success of the new Matching Program.

C. Matching Programme: CFBS Scheme

In a trial to define the parameters of a matching program acceptable to the granting councils, the institutions and the private sector, CFBS submitted the following scheme to the attention of the Honourable Michael Wilson, Minister of Finance, on May 1, 1986, and give it the forward of a recommendation to the Forum:

RECOMMENDATION:

In order to optimize the efficiency of the Matching Programme (i.e. attract new money from private sector quickly,

maximize the fraction of the matched money being given to the granting councils and minimize the operating costs), the Government should build on existing arrangement among the institutions, the granting councils and the private sector, in the following way:

1. The private investor that does qualify for the Matching Program should receive an attractive incentive in terms of tax credits, after he paid the full costs of the research contract, as it is the case now, to the university.

2. The institution or the investigator who did recruit the private investor's contract or donation would submit an application for the Matching Program to the pertinent council, and accordingly receive 15% of the matching fund attached to this specific research contract or donation. In the case of a research contract, this would be a net incentive of 15%, since there are provisions covering overhead cost in the actual research contract. We believe that such a figure (15%) is sufficient to act as an incentive to the investigator-university system, and small enough to prevent the private investor to "level down" or invest less for the same pay-off.

3. After ensuring that the eligilibity criteria are met by applicants, the Granting Councils would submit the application to the Government. The matching funds would then flow, to be partitioned two ways: at least 85% would go directly to the relevant granting council to support its base programs; the remaining portion (up to 15%) would go directly to the recruiting individual or the institution for the support of eligible research in any area of endeavour.

4. As far as the eligibility criteria are concerned:

a) Donations from private sector as well as research contracts should be eligible to the Matching Program;

b) The eligible research sould be defined to include all activities considered as research and scholarship by universities and the granting council. We would like to suggest the following definition which encompasses both basic and applied research as well as development:

> "Research and development is exploratory and innovative work undertaken on a systematic basis towards the acquisition of new knowledge in new ways. New knowledge involves the integration of newly acquired information into existing hypothesis, the formulation and testing of new hypothesis or the re-evaluation of existing observations".

The abovementioned scheme for Matching Programme has the following advantages:

a) It involves a minimum of bureaucratic complexity.
b) By avoiding channeling private sector money directly through the Councils, it circumvents the necessity for the councils to peer review the applications, since this work as well as ethical aspects and rights of publication will be looked after at the university level, as it is done with all research contacts.
c) It contributes to regional economic development by attraction more industrial regional money that will be beneficial to local universities, institutions and investigators.
d) It precludes competition between individual researchers, institutions and funding councils for private sector funds.
e) It does not undermine the basic objectives of the granting councils.

2. What can be done to strenghen corporate-higher education partnership?

As mentioned in the book Spending Smarter, recently published by the Corporate-Higher Education Forum, there are two categories of specific barriers to corporate-university cooperative research: the basic barriers and the motivational barriers.

The basic barriers are relatively unimportant or potentially easy to overcome. The differing nature of university and corporate research is more of a reason than a barrier for cooperative research. Concerning confidentiality, corporations are probably ove ly secretive, however itcannot envisage submitting a paper for publication before patent protection is obtained. Corporate concerns about the project management skills (budgets, deadlines, objectives) of professors are probably unfounded since professors already manage budgets and have their own deadlines and obligations to granting agencies as well as their university.

The motivational barriers are real and much more difficult to overcome. Only time, experience and familiarity will appreciably reduce these obstacles. The problem of assembling interdisciplinary teams will only be resolved with experience. It can be hard enough getting an interdisciplinary team together for an intra-university project, let alone a project from outside the university. The problem stems, at least, in part, from the premium placed on university researchers being independent with one's own research grant. Corporations should initially concentrate on collaborative projects with one or two university researchers before embarking on multidisciplinary projects.

Improving communication between university and corporate researchers is an important step in facilitating collaborative projects. These are the people who will have to set up and engage in the collaborative efforts, and their success or failure will determine how the process evolves.

CFBS is considering the following course of action to encourage interaction. If member societies want to cultivate corporate contacts, encouragement should be given to recruiting scientists from corporations and government as members. Part of this process may entail ensuring that there are no artificial barriers to membership for these scientists. As a complimentary step, it would enhance corporate visibility and university contacts if more presentations from industry were forthcoming at the CFBS annual meeting. An additional source of interaction could result from inviting corporate scientists to universities to give lectures or seminars, as part of existing programs or as a special series. A means of promoting interchange as well as providing a mechanism for directly facilitating cooperative research would be the co-sponsorship of post-doctoral fellows by a university and a corporation. Such arrangements could also enhance the subsequent employment prospects of such fellows.

We believe that increased corporate R & D will only come out of increased corporate R & D spending in general, (i.e. it will not supplant current in-house corporate R & D) regardless of what happens in government R & D. Unfortunately, there are additional barriers to this increased R & D in general. There barriers are a function of the nature of the Canadian political and economic system which is resource and branch-plant oriented in many aspects. In our own field, we cannot see any increase in innovative pharmaceutical R & D (or related emerging

biotechnology) occuring until there is patent protection of intellectual property (as it applies to medicines and foods) to something approaching the levels provided in other developed countries.

3. Patent Act: The Cornerstone of Pharmaceutical Research done in Canada

Even though the updating of Patent Act was identified as priority item at the February 1985 Federal-Provincial Meeting of Ministers responsible for Science and Technology (Science Technology and Economic Development, A Working Paper, Feb. 4-5, 1986, p. 3) nothing has been done yet by the Federal Government with that respect for the pharmaceutical industry.

Adequate protection is the basic condition providing the necessary climate to develop and acquire new knowledge, put this knowledge to work and exploit opportunities in the sector of pharmaceutical research, as it is the case for any other sector of research. Unless this basic condition is met Canadian Government's willingness to set aside international patent agreements when it is politically desirable is unacceptable. We are the only Western nation ever to have done that. The presumption has always been that patents protect intellectual material. In taking the action that we have, Canada has implied that it does not believe that as a nation we have intellectual material to protect. There are at least two very important principles at stake here. First, we cannot make a case for research as an important element in our economy if we ourselves do not defend the fact that intellectual material that proceeds from research must be protected. The second principle is enunciated in our Brief to the Commission of Inquiry of the Pharmaceutical Industry (Eastman Commission), submitted in August 1984, whose copy is appended (*see Appendix A*).

We pointed out that Canada alone of the Western nations does not have a substantial domestic research-based pharmaceutical industry. This explains why "Canada's share of potential product inventions is low in ...high technology product areas such as pharmac uticals, medicine...", as well as our poor rating (7th OECD nations) for R & D Sales of Drugs and Medicine. We are missing out on a financial, intellectual and industrial opportunity. (Building on our Strenghts (draft), MOSST, April 22, 1986, p. 15 and 17).

Subsequent to a thorough consultation with Heads of Departments of Pharmacology of all Canadian universities and with the 31 members of the Science Policy Committee of our Federation, a Joint Position Paper of the Pharmacological Society of Canada(PSC) and of CFBS on the Report of the Eastman Commission was submitted to the Minister of Consumer and Corporate Affairs, the Honourable Michel Côté, on October 29, 1985, and discussed with him on February 24, 1986. Our Joint Position Paper contains specific recommendations for Patents and Royalties whose application would not only re-establish and further expand an active pharmaceutical industry in our country, but it would also increase markedly the share of Canadian R & D effort, supported by this industry. This document, as well as the supportive views of Ministers Côté, Epp and Oberle about it, will be found on *Appendix B and C.*

Recently, CFBS and PSC issued a News Release urging amendments to Patent Act along the lines suggested in our Joint Position Paper, in a trial to get concrete measures tabled by the Government. Copy of the News Release will be found in *Appendix D.* Using 1985 Sales to Retail for the Pharmaceutical Industry and for the Generics, we estimated that the combined effect of the implementation of our recommendations would

Generate approximately $150 million investment in pharmaceutical research done in Canada. Moreover, on a short and mid-term basis, we believe that pharmaceutical industry is the only realistic source of private sector contribution that will allow the Medical Research Council to reach the matching fund levels ($111 million) it desperately needs to maintain its 1985-86 purchasing power over the next 5-years, along with the Federal 5-year Funding Plan recently adopted.

RECOMMENDATION

In order to ensure that (i) Canadians obtain the benefits of increased indigenous research and industrial development, and that (ii) drug prices do not rise beyond average world level, it is recommended that Federal Government be urged to table concrete measures that will link the extended patent protection to the amount spent by the pharmaceutical companies on research in Canada and to drug prices.

LIST OF RECOMMENDATIONS

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APPENDIX A

CFBS BRIEF TO EASTMAN COMMISSION

CANADIAN FEDERATION
OF
BIOLOGICAL SOCIETIES

CFBS FCSB

FEDERATION CANADIENNE
DES
SOCIETES DE BIOLOGIE

Brief to Eastman Commission

Submitted on behalf of the Canadian Federation of Biological Societies

The Canadian Federation of Biological Societies is a Federation of Scientific Societies concerned with the Basic Medical Sciences. The membership of CFBS consists of

1) The Canadian Physiological Society,
2) The Pharmacological Society of Canada,
3) The Canadian Association of Anatomists,
4) The Canadian Biochemical Society,
5) The Canadian Society for Nutritional Sciences,
6) The Canadian Society for Cell Biology,
7) The Canadian Society for Immunology and
8) The Society of Toxicology of Canada

These societies together have a total membership of approximately 3,500 scientists.

The Canadian Federation of Biological Societies has maintained a Science Policy Committee for many years which is charged with dealing with policy issues in science as they pertain to members of CFBS. This brief is submitted on behalf of that Science Policy Committee. The Pharmacological Society which has made a separate individual submission to you, but also supports this brief.

The purpose of this submission is not to propose details of legislative change. The purpose rather is to point out some facts that may or may not be obvious to your commission and which point to the need for a legislative framework that will permit growth and development of a substantive research-based Pharmaceutical Industry in Canada.

Unlike virtually every other major developed country, Canada has only a minor native pharmaceutical industry. Every developed country in the Western World has based in it one or more major pharmaceutical corporations. These have become multi-national corporations which are significant contributors to their domestic economies. Countries with a major pharmaceutical industry include Switzerland, Sweden, Denmark, Great Britain, Germany, France, Italy, Holland, United States, and even Eastern European countries such as Hungary. Every one of the major pharmaceutical company conducts a substantial research effort, for new products are a major source of

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growth for these industries. To give you a measure of the size of these research budgets, Burroughs Wellcome (a relatively minor player) in 1981/82 had a research budget of $160 million (U.S.). The size of that budget exceeded by a considerable margin the budget of the Medical Research Council of Canada for that year. Even now the current operating base budget of the Canadian MRC is only $117 million. The research effort of the pharmaceutical industry world-wide is substantial. Even the attenuated Canadian industry claims to currently spend approximately $100 million a year on R&D, or an amount equal to 85% of the MRC budget.

The research efforts of the pharmaceutical industry are not only a source of profit for the companies, but many of the discoveries made by the pharmaceutical industry have been and are of huge benefit to mankind. They have substantially reduced the impact of some diseases and virtually abolished others. We, in Canada, have at times made major contributions in this enterprise. Yet, despite the fact that Canadian biomedical scientists are among the best in the world they have not been substantially employed in a domestic pharmaceutical industry. Many other briefs will set out for you the reasons which their authors believe explain why this has occurred. Many of those briefs will deal specifically with the impact of licensing legislation. A major purpose of this Brief from the Canadian Federation of Biological Societies is to point out that our failure to develop a substantial pharmaceutical industry it is not due to any lack of ability to produce the trained manpower to do the job. The Universities of Canada are as effective as any other Universities in any other jurisdiction in turning out the properly trained chemists, pharmaceutical chemists, pharmacologists, physiologists and biochemists and other scientists who together constitute the highly qualified manpower who underly an enterprise in pharmaceutical research. Indeed, many employees of major U.S. enterprises occupying positions of leadership in that industry received their training in Canada.

Unfortunately, although the Universities of Canada have the means to provide the highly qualified manpower, the outlook for graduates of these programs in Canada is bleak. The bulk of the Pharmaceutical Industry research in Canada is concentrated in such areas as clinical trials and toxicity testing. Valuable and necessary as these activities are they generate little real new wealth. Only a few Canadian companies are engaged in frontier research, the kind that uses highly qualified scientists to create new sources of wealth.

The country is weakened economically by the absence of such activity. The Universities of Canada are weakened academically by the lack of influences provided by a well developed pharmaceutical industry. In countries such as Switzerland, the U.K. and the U.S.A., there has been a vigorous and active interchange of personnel and ideas between industry and Universities. Thus the professoriate in the Universities move easily into positions in the pharmaceutical industry and back again. The Universities in those countries contain scientific staff with a good industrial background and this influences the quality of teaching and the relevance of programs in the Universities. The requirements of the pharmaceutical industry influence the University

very positively and in turn the Universities help Industry. Over the years the Pharmaceutical Industry in these countries have not only broadened the scope of the Universities, but many companies have given strong financial support directly and indirectly to their Universities. Canada is missing out on a major employment opportunity for its University Science graduates and a major source of resources and stimulation for its Universities..

The question of industrial ownership will be raised and it will be pointed out that easing of licensing laws will simply act to benefit the multi-national companies who remit a substantial proportion of their profits out of Canada. This is perfectly true, but it also must be recognised that the Pharmaceutical Industry is a high-technology industry. Native high-technology industry can only grow in Canada if there is a pool of highly trained people capable of running all aspects of the industry. The pool of individuals in Canada capable of imaginative leadership of such an industry is largely absent because of the paucity of the pharmaceutical enterprise. It is essential that steps be taken to expand a research-based pharmaceutical industry in Canada even though in the initial stages that industry may be largely foreign owned. The steps that have to be taken to ensure the emergence of a domestic industry can be matters for later legislation. Perhaps even such legislation will prove unnecessary and the process of evolution and maturation will provide the individual Canadian entrepeneurs who will generate the new industry.

We know that your Commission will be under pressure to keep the costs of pharmaceutical products as low as possible. This is the aim of consumer groups and those within Provincial Health Administration trying to contain health care budgets. Cost containment is a laudable aim, but it must be balanced against the need to maintain a viable pharmaceutical industry. We have heard a great deal of talk in recent years about the fact that the recombinant DNA technology can generate whole new industries and new jobs. It should be remembered that most of the companies now active in the recombinant DNA enterprise either are arms of existing large pharmaceutical enterprises, or are combinations of recently organised companies as consortiums with well established older pharmaceutical companies. Recombinant DNA technology alone is not enough. It must be exploited and part of the successful exploitation will depend on the presence in Canada of an industry used to dealing with the production and marketing of the products of recombinant DNA technology. The industry best suited to do that in critical areas is the pharmaceutical industry. The <u>fair</u> cost of drugs is the price for a sound economic potential based on a strong industry.

Drug pricing may be unfair and predatory trading practices may be exposed. What is then needed is legislation specifically designed to deal with those issues which are essential. A legislative blunderbuss , such as the present Section 41 of the Canadian Patent Act, no matter how appealing to unsophisticated consumer and to the bureaucrat is not the weapon of choice. It must be understood that cheap drugs, like cheap food or cheap fuel carry a hidden price tag. Those advocating a cheap drug policy above all else shoulder the responsibility for the inadequate exploitation of a significant portion of our Universities and

the brain power of the nation. Cheap drugs are achieved by reducing the opportunity for gainful employment for our brightest young people. If the present licensing laws are a barrier to the development of the pharmaceutical industry, then they must be modified. We need incentives, not barriers to the development of a pharmaceutical industry and its research and development component in Canada.

The issues have frequently appeared as a dispute between an industry and a consumer group. However, major matters of national interest are at stake. The Science Council of Canada has repeatedly provided the evidence of the need for science-based industry in this country. In its report on Canadian Industrial Developments (#37), the Science Council points out that an indigenous R&D is usually a pre-requisite for the absorption of foreign techology. For Canada, a strong indigenous R&D based pharmaceutical industry is essential. Indigenous R&D in the pharmaceutical industry, will only grow to reasonable levels if the licensing regulations are removed.

V.C. Abrahams
Member, Board of Directors,
Member, Science Policy Committee,
On behalf of the Science Policy Committee
Canadian Federation of Biological Societies

August, 1984

APPENDIX B

JOINT POSITION PAPER OF PSC AND CFBS OF THE REPORT OF THE COMMISSION OF INQUIRY OF THE PHARMACEUTICAL INDUSTRY (EASTMAN COMMISSION)

Joint Position Paper of the Pharmacology Society of Canada (PSC)
and of
the Canadian Federation of Biological Societies (CFBS)
Science Policy Committee
on the Report of
the Commission of Inquiry of the Pharmaceutical Industry
(Eastman Commission)

The Eastman Commission represents an extensive, detailed study of many facets of drug manufacturing and marketing in Canada as well as an in depth analysis of the effect of mandatory licensing on the Canadian Pharmaceutical Industry and the costs and benefits derived from such licensing on the health care system. Many observations made and conclusions drawn about Pharmaceutical Research and Development in Canada are clearly presented from the perspective of an economist with little attention paid to the concerns of research scientists and health care professionals.

We will briefly discuss each of the main recommendations of the Eastman Commission and make alternate recommendations that we believe to be necessary. However, we feel <u>it is essential for us to express our disagreement with the Commission's concept of research.</u> Specifically, we do not believe that those activities carried out by drug companies which are required by the Health Protection Branch in order to certify the therapeutic efficacy and the safety of a particular drug can all be classified under the heading of research. Though some activities may indeed involve experiments designed to obtain new information, others are done explicitly to guarantee the clinical efficacy and safety of a compound and do not constitute original contributions to knowledge.

The Commission divides its recommendations into four categories: 1-Patents and Royalties, 2-Authorization for Marketing: Safety and Efficacy, 3-the Retail Market and 4-Pharmaceutical Research in Canada. The intent of the second group of recommendations (9.1-9.8 found on pp 330-331), i.e. <u>the streamlining and consequently more expeditious handling of requests for the approval of new drugs or new uses of existing drugs in Canada receives our full support.</u> It must be pointed out however that a number of the recommendations are already in place at the HPB e.g. the use of experts from Universities on advisory panels, and that others would require a major expansion of the budget required to run the HPB. We do not feel that drugs approved in other countries, whose standards are often different from our own, should necessarily be approved <u>a priori</u> (recommendation 9.4, p.331). The third group of consumer oriented recommendations (10.1-10.5 found on p. 331) should provide greater freedom of choice for the consumer and allow him (her) to reach decisions on the purchase of drugs in a more informed manner.

<u>We do not agree, however, with the Patents and Royalties set of recommendations.</u> The underlying assumption in these recommendations is that it is not possible for a country like Canada to develop or to attract a thriving pharmaceutical industry. Dr. Eastman cites as a major reason for this contention our small size and our lack of "scientific manpower or the physical infrastructure that would make it

[Canada] a major world centre for basic pharmaceutical research" (p.423). The concept that we must maintain, in Canada, a branch plant approach to the pharmaceutical industry permeates the Commission's report. We believe that such an attitude can become a self-fulfilling prophecy if left unchecked. There are several countries of similar size to Canada or smaller such as Sweden, Denmark, Switzerland and Italy, that have drug firms which effectively compete on a world-wide basis.

Our specific objections to the recommendations on Patents and Royalties are as follows:

1-The only reason for providing a period of four years of protection for mandatory licensing after receiving the Notice of Compliance authorization is apparently to allow the manufaturer to recover his marketing and advertising costs. There is no indication that the additional profits derived from this period of exclusivity will in any way profit the Canadian economy or the research component of the development of new drugs in Canada. Furthermore, the Commissioner does not explain how he has reached the magical figure of four years. There is no other country in the world, to the best of our knowledge, that employs such a figure. We strongly reject this proposal and present an alternative recommendation below.

2-The second major recommendation under the heading of Patent and Royalties is the establishment of a Pharmaceutical Royalty Fund. The sailient features of such a Fund are that the income for this Fund would be derived from generic firms and would be based on the amount of R&D, on a world-wide basis, done by the firms holding the patents. It is our interpretation of the report that the Fund would be disbursed periodically to these same patent holding companies on the basis of <u>world-wide</u> research efforts. Once again, it is apparent that the Commissioner does not believe that funds should be spent in Canada for the research and development of new drugs even if such funds are raised from Canadian generic drug firms. We agree that generic firms should be "taxed" for not having done the R&D required for the product they are selling, and we agree with the principle that these funds could be returned to the companies that are actively doing research in the field of new drug development, but we strongly disagree with the concept that these funds should be exportable out of Canada by these companies.

3-The only recommendation made by the Commission on Pharmaceutical Research in Canada is that government departments review their policy on granting funds to firms in Canada. <u>No mention is made of the potential for an active Canadian R&D effort.</u>

The alternative recommendations we would like to put forth for Patents and Royalties are as follows:

1-All new drugs developed in Canada, whether using biotechnology or not, should be protected from mandatory licensing for the full twenty year life of the patent. This would apply not only to companies based in Canada but also to multinational companies that have a branch of their research activities in Canada. We recommend a twenty-year period for patent protection because a) it takes

approximately ten years from the time a patent is given to the time a Notice of Compliance is granted thus leaving the manufacturer only ten years to profit from his research investment, b) this period of time is that most commonly used in other countries.

2-All companies actively developing new drugs in Canada would be entitled to full patent protection and freedom from mandatory licensing for the period of the patent for all of their products sold in Canada. The nature of research done by these companies must include not only those studies required by the HPB e.g. clinical drug trials, but also consist of an active basic research component. Research done in the companies' own facilities as well as research contracted to commercial laboratories and universities would qualify. We feel that this protection is essential not only to allow major drug firms to re-establish their research presence in Canada, but also to guarantee that the few companies still actively doing research in this country do not leave.

3-The development of a Pharmaceutical Royalty Fund as outlined in the Commission report is desirable. We believe that the disbursements from this fund should be made to eligible companies actively doing research in Canada. Those funds raised by the sale of compounds (drugs and biotechnology products) whose patents are held by companies not involved in research in this country would be made available either to other companies or to researchers in Universities and Research Institutes. The disbursements of such funds would be based on a peer review system of applications made to the Fund.

We are being presented with the unique opportunity to (i) re-establish and further expand an active pharmaceutical industry in this country and (ii) increase the share of Canadian R&D effort supported by industry. The volume of highly trained research personnel already exists in Canada. The teaching and research programmes in our Universities and Research Institutes provide a continuous flow of research personnel and the opportunity for collaborative research between industry and academia. We urge the Government to encourage the development of an active pharmaceutical industry in Canada not only by reestablishing the patent protection that existed in Canada before 1969 and currently exists in most other developed countries but also by introducing the necessary tax incentives to facilitate a thriving drug industry based in this country.

October 1985

APPENDIX C

LETTERS FROM HON. MICHEL COTE, JAKE EPP AND FRANK OBERLE

Minister
of Consumer
and Corporate Affairs

Ministre
de la Consommation
et des Corporations

CANADA

The Honourable L'honorable
Michel Côté

MAR 18 1985

Dr. Clément Gauthier
Science Policy Officer
Canadian Federation of Biological
Societies
575 King Edward Street
Ottawa, Ontario
K1N 7N5

Dear Dr. Gauthier:

I am writing to acknowledge receipt of your letters to the Right Honourable Brian Mulroney and the Honourable Sinclair Stevens dated October 31, 1985 and November 5, 1985 respectively regarding the report of the Eastman Commission.

I appreciate your concerns with regard to the future of the innovative sector of the pharmaceutical industry in Canada.

I must point out, however, that the recommendations of the Eastman Commission are but one of the sources of information being considered in the formulation of policy on this matter. Consultations subsequent to the release of the Eastman report have proven productive in this regard. As a result, some interesting propositions have been brought forth recently, and my colleagues and I are continuing to give high priority to settling the issue as soon as possible.

I appreciate your taking the time to share your views with us.

Yours sincerely,

Michel Côté

Michel Côté

Minister of National Health
and Welfare

CANADA

Ministre de la Santé nationale
et du Bien-être social

OTTAWA, K1A 0K9

20 XII 1985

Clément Gauthier, Ph.D.
Science Policy Officer
Canadian Federation of
Biological Societies
575 King Edward Avenue
OTTAWA, Ontario
K1N 7N5

Dear Dr. Gauthier:

Thank you for your letter of October 30, 1985, and the accompanying Joint Position Paper of the Pharmacology Society of Canada and the Canadian Federation of Biological Societies on the Report of the Commission of Inquiry of the Pharmaceutical Industry (Eastman Commission).

The government has been reviewing the findings contained in Dr. Eastman's comprehensive study, together with other research in the area. I note that you have also presented this position paper to my colleague, the Honourable Michel Côté, Minister of Consumer and Corporate Affairs and Minister responsible for Canada Post.

I shall be working with the Minister and other members of Cabinet to develop workable policies in the drug field that will protect the patient from undue price increases and at the same time foster a climate of

...2

opportunity for the industries and institutions providing goods and services to the health care sector. I am particularly interested in stimulating research efforts that complement and improve health care in Canada.

Again I wish to thank you for bringing the thoughtful views of the Pharmacology Society of Canada and the Canadian Federation of Biological Societies to my attention.

Yours sincerely,

Jake Epp

Minister of State
Science and Technology

Ministre d'État
Sciences et Technologie

Canada

JAN 13 1986

Clément Gauthier, Ph.D.
Science Policy Officer
Canadian Federation of
Biological Societies
575 King Edward Avenue
Ottawa, Ontario
K1N 7N5

Dear Dr. Gauthier:

Thank you for your letter of October 30th, 1985, addressed to my predecessor, the Honourable Tom Siddon, enclosing the joint position paper indicating the views of the Pharmacological Society of Canada and the Canadian Federation of Biological Societies on the report of the Eastman Commission.

It is clear that many serious efforts to provide a definition of research and of development upon which all members of the scientific and industrial communities can agree have not produced a universally acceptable statement. I shall bear your concern with the definition selected by the Commission in mind.

As you may know, my colleague, the Minister of Consumer and Corporate Affairs, the Honourable Michel Côté, is currently examining the recommendations of the Report in detail, and is considering a variety of options which Canada might adopt to respond to the kind of concerns you note in your paper.

As Minister of State for Science and Technology, I am concerned that the laws of this country contribute to the creation of a healthy climate for both university and industry-based research and development in all fields. It is clear that the intellectual property rights of researchers in the pharmaceutical field must be given adequate protection to ensure that there is a strong incentive to do research and to commercialize the results for the benefit of Canadians. At the same time, however, the cost of significant drug price increases to individual Canadians and to taxpayers in general must be recognized. An acceptable solution to this issue must ensure that Canadians will obtain the benefits of increased indigenous research and industrial development, and that drug prices do not rise beyond average world levels.

Ottawa, Canada
K1A 1A1

I believe that Canada, with its strong medical schóols, active research community, and its well developed hospital and treatment system offers many attractions to pharmaceutical firms wishing to work here. In the coming months, the government will make every effort to reach a solution which adequately addresses the concerns of all Canadians.

I thank you for your consideration in providing me with the views of your members on these important issues.

Yours sincerely,

Frank Oberle

APPENDIX D

NEWS RELEASE

"Biolocial Researchers urge Amendments to Patent Act".

CANADIAN FEDERATION
OF
BIOLOGICAL SOCIETIES

CFBS FCSB

FEDERATION CANADIENNE
DES
SOCIETES DE BIOLOGIE

EWS RELEASE - NEWS RELEASE - NEWS RELEASE - NEWS RELEASE - NEWS RELEA

FOR RELEASE: Tuesday, March 4, 19

BIOLOGICAL RESEARCHERS URGE AMENDMENTS TO PATENT ACT

OTTAWA - Four months after the submission of a Joint Position Paper on the Report of the Commission of Inquiry of the Pharmaceutical Industry (Eastman Commission) to the Minister of Consumer and Corporate Affaires, biological researchers urge the Mulroney Government to bring the amendments to Patent Act that are necessary to re-establish a thriving pharmaceutical industry in Canada, increase the share of Canadian research effort supported by this industry, and stop the ongoing brain drain by creating jobs for our young scientists.

The position paper results from a thorough consultation completed last fall with Heads of departments of Pharmacology of 16 Canadian universities. It has been endorsed by the Pharmacological Society of Canada (PSC) and by the Canadian Federation of Biological Societies (CFBS), an organization representing nearly 4 000 biological researchers in Canada.

575 King Edward, OTTAWA, Ontario Canada K1N 7N5 Tel.: (613) 234-9555

According to Dr. Radan Capek, President of PSC, "patent protection should be linked to the amount spent by the pharmaceutical companies on research in Canada. There would be no protection unless substantial investment is committed to canadian research."

In agreement with Eastman Report, researchers support the development of a Pharmaceutical Royalty Fund. However, they specify that such funds generated by the sale of compounds whose patents are held by generics, should be made available to researchers in Companies, Universities and Research Institutes, based on a peer review system. Based on a total 1985 Sales to Retail of $1,841millions for the Pharmaceutical Industry and $132 millions for the Generics, the combined effect of the implementation of these recommendations would generate approximately $150 millions investment in research by the pharmaceutical industry in Canada. Also, in agreement with the Eastman Commission, the scientific community urges the government to provide necessary resources so that Canadian consumers can benefit from new drugs more rapidly.

"We urge the Government to encourage the development of an active pharmaceutical industry in Canada by re-establishing the patent protection that existed in Canada before 1969 and currently exists in most other developed countries who are concurrently enjoying a larger participation of the private sector to their national research effort", to conclude Dr. Barry D. McLennan, President of CFBS.

- 30 -

For more information, please contact:
Dr. Radan Capek, President, PSC, Montreal, (514) 392-5763
Dr. Barry D. McLennan, President, CFBS, Saskatoon, (306) 966-5751
Dr. Clément Gauthier, Science Policy Officer, CFBS, Ottawa (613) 234-955

DOCUMENT: 830-220/019

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Innovation, Technology Transfer and Small Business Development

Canadian Federation of Independant Business

June 8-10, 1986
Winnipeg, Manitoba

EXECUTIVE SUMMARY

INNOVATION, TECHNOLOGY TRANSFER AND SMALL BUSINESS DEVELOPMENT

Paper prepared by the Canadian Federation of Independent Business for the National Forum on National Science and Technology Policy, Winnipeg, June 1986.

Introduction

Most general discussion on the development of small business in Canada usually centres on the broad issues of small business policy -- i.e. financing, management, taxation, and regulation. A comprehensive approach to the development of small business requires that significant attention must also be paid to the issues of new technology development and transfer to the small business sector.

The competitive advantages of using new technologies have not gone unnoticed by independent business men and women all across our country. In a comparative, 11 national survey conducted by the C.F.I.B. in conjunctions with the International Small Business Congress, it was the Canadian business community that ranked higher than all other developed nations in regard to the degree in which they were searching for information on technological changes that could be used in their business.

In addition to being important users of new technology, small business in Canada also has a major role in the research, development and production of new technology. Based on a survey of American R. & D. companies, small firms take 27% less time to complete the R. & D. cycle - from initial research and design to bringing the product to market. Small R. & D. companies also have 2.5 times as many innovations per employee as large R. & D. firms.

The purpose of this paper is to examine both of these aspects of technology transfer -- direct innovation by small business in development and transfer of new technology to the market place, as well as the adoption and transfer of these new technologies to improve productivity throughout all sectors of the small business community.

Part I - Technology Transfer and Small Business Productivity

Independent small business faces numerous obstacles in acquiring modern technology. This is principally due to the struggle to retain sufficient earnings for investment in new technology, and because their very independence often prevents proper access to information on new technological problems, or to even recognize the existence of a potential problem due to antiquated technical processes and equipment.

In order to overcome these barriers, several strategies are proposed to help the small and medium sized business sector recognize, acquire and adopt new technology. We believe that increased productivity through technology transfer can only be realized by improving the overall climate for small business financing and new capital investment. It is also necessary to improve access by small business to market information and technological expertise - especially from non-government sources of information which carry higher credibility within the independent business sector. The C.F.I.B. also notes that the best way to transfer technology is by the interchange of people with the technological "know how" to small business - either through co-operative university/industry study programs or through increased small business interaction from procurement with large R. & D. firms and research organizations.

Part II - Innovation Through Small Business

The C.F.I.B. feels that too much attention has been placed on the need to increase R. & D. in Canada, compared to the "real issue" which is the commercialization of research which has already been completed. A

far more serious statistic is the very large and growing trade deficit that Canada suffers in technology-based goods and services.

In response to this growing problem the C.F.I.B. staunchly believes that a new science policy for the country must focus more on entrepreneurship and commercialization of research, rather than simply more R. & D. We may already have more technology than we know how to exploit. The creation and develpment of new technology products and technology-related services from small business are ultimately the only means of keeping Canada competitive and economically independent in this New Technology Age.

To catch up with this changing world economy, we must encourage new entrepreneurship at a rate unsurpassed in recent Canadian history. Recommendations put forward in this paper include the promotion of more entrepreneurship by scientists in universities and government; a simplified system of tax incentives (not grants) to increase industrial R. & D.; and the removal of other government barriers to innovation such as rigid policies of government procurement and regulation.

CONCLUSION

Viewed from the traditional perspective of strong government intervention in the economy, it is little wonder that the process of technological innovation seems so mystifying. We are moving through a turbulant era in history in which the rate of technological change defies all attempts to centrally quantify, regulate and control everything that is happening around us. Like the "primitive" computers before the microchip, our economic policies of even just ten years ago now seem very big, very slow, and awkwardly out of place.

In order to keep pace with this technological revolution, old methods of direct economic regulation and targetted subsidies are fast becoming obsolete. Technology information services need no longer remain the purview of remote central government repositories. Structural "monuments" to encourage innovation and training are becoming hopelessly out-dated and unresponsive to current societal needs. Direct government R. & D. assistance to high tech business can take almost as long to deliver as the entire commercial lifetime of the new products that these programs are designed to help develop.

Therefore to fully understand and maximize the economic opportunities caused by this technological revolution, government economic policies must try to mimic the decentralizing and liberating features of this new technology itself.

The rules of the new economy are really quite simple:

1. Government must help prepare society for the age of the entrepreneur.

2. Government must encourage more self-help, group networks and individual decision-making rather than the influence of a central economic program or plan.

3. Lastly, and perhaps most important of all, governments must have the courage to recognize the many elements of their own obsolescence, and resist the temptation to centrally plan the new decentralized economy that is emerging. Governments, however, can facilitate the process of adjustment by supporting entrepreneurship, new venture formation and a positive business climate for innovation and growth.

DOCUMENT: 830-220/019

Fédération canadienne de
l'entreprise indépendante

L'INNOVATION, LE TRANSFERT DE TECHNOLOGIE ET LE DÉVELOPPEMENT DES PETITES ENTREPRISES

MÉMOIRE À LA CONFÉRENCE SUR LA
POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

le 8-10 juin 1986
Winnipeg (Manitoba)

PRECIS

Introduction

C'est sur les grands problèmes de la Politique de développement des petites entreprises: financement, gestion, fiscalité et réglementation, que porte en général le débat à son sujet. Mais une approche systématique nécessite qu'on accorde aussi beaucoup d'attention au développement du savoir-faire technique et à sa communication aux PME.

Les chefs de ces entreprises indépendantes, partout au Canada, ont sans aucun doute pensé aux avantages que pourrait leur procurer l'emploi de la technologie nouvelle, sur le plan de la concurrence. Une enquête comparative nationale menée par la Fédération, de concert avec le Congrès international de la petite entreprise, a montré que le secteur des PME du Canada s'intéressait, plus que celui des autres pays, aux progrès techniques dont elles pourraient bénéficier.

Outre cette utilisation importante du savoir-faire nouveau, les petites entreprises canadiennes jouent un grand rôle en recherche, développement et élaboration de la technologie nouvelle. Selon une enquête menée auprès de petites firmes étatsuniennes fortement axées sur la recherche, celles-ci prennent 27 pour cent moins de temps que les grandes pour parcourir le cycle complet allant de la recherche initiale à la conception du produit, puis à sa commercialisation. Ces mêmes petites entreprises fortement axées sur la recherche font 2,5 fois plus d'innovations par travailleur que les grandes firmes d'orientation semblable.

Dans ce mémoire, nous examinerons les deux aspects du transfert de technologie: d'une part l'innovation directe par la petite entreprise développant la technologie nouvelle,puis lui donnant

une expression concrète dans le commerce et, d'autre part, la diffusion et l'adoption de la technologie nouvelle afin d'améliorer la productivité dans toutes les branches du secteur des PME.

I[ère] partie. Le transfert de technologie et la productivité des PME

Les petites entreprises indépendantes rencontrent de nombreuses difficultés pour acquérir le savoir-faire technique nouveau. La principale raison en est qu'il leur faut lutter pour retenir suffisamment de rentrées pécuniaires afin de mettre en oeuvre ce savoir-faire, et aussi que leur indépendance même les empêche souvent d'avoir accès à l'information concernant les nouveaux problèmes techniques, ou de se rendre compte de l'existence même d'un problème éventuel, en raison d'un équipement ou de processus de fabrication désuets.

On a proposé plusieurs lignes d'action pour aider les PME à franchir ces barrières à l'acquisition et à l'adoption de la technologie nouvelle. Nous estimons qu'il est indispensable d'améliorer les conditions de financement des PME et leur accès au capital d'investissement pour les aider à acquérir le savoir-faire technique nouveau, et à améliorer ainsi leur productivité. Il est également nécessaire de développer l'accès des petites entreprises à l'information sur les marchés et aux techniciens compétents, particulièrement auprès des sources d'information hors secteur public, lesquelles sont plus crédibles, selon les PME. La Fédération a également remarqué que l'échange de spécialistes ayant le savoir-faire requis constituait le meilleur mécanisme de diffusion de la technologie nouvelle. Cet échange peut s'effectuer dans le cadre de programmes d'études universitaires et de stages industriels alternés, ou de contrats d'approvisionnement accordés aux PME par les grandes entreprises axées sur la recherche, ou par les établissements de recherches.

II^{e} partie. L'innovation par les PME elles-mêmes

La Fédération estime qu'on a trop mis l'accent sur la nécessité d'accroître l'effort de R-D du Canada, et pas assez sur le problème réel, qui est de concrétiser par des produits commerciaux les résultats déjà disponibles de la recherche accomplie. Le très fort déficit, toujours croissant, de la balance commerciale de notre pays au titre des produits et des services de pointe constitue un problème bien plus épineux.

La Fédération croit fermement que, pour résoudre ce problème, la nouvelle politique des sciences de notre pays devrait favoriser plus largement l'esprit d'entreprise et la concrétisation commerciale des résultats de la recherche, plutôt qu'un simple accroissement de l'effort de R-D. Il est probable que nous disposons déjà de plus de savoir-faire nouveau que nous ne pouvons en mettre en oeuvre. La création et le développement de produits techniques et des services pertinents par les petites entreprises constituent finalement les seuls moyens de maintenir le pouvoir concurrentiel de notre pays et son indépendance économique dans cette ère de mutation technologique.

Il nous faut encourager le développement de l'esprit d'entreprise à un rythme inconnu dans le passé récent du Canada, pour mettre notre pays au diapason des changements qui se produisent sans cesse dans l'économie mondiale. Dans ce mémoire, nous recommandons: le développement de l'esprit d'entreprise parmi les scientifiques des universités et du secteur public, la simplification du mécanisme de dégrèvements fiscaux (non l'augmentation des subventions) pour encourager la R-D dans l'industrie, et la suppression des autres obstacles administratifs à l'innovation, tels que les règles rigides d'octroi des marchés publics et la réglementation officielle.

CONCLUSIONS

Il n'y a rien de surprenant à ce que le processus d'innovation technologique paraisse si déroutant à ceux qui l'envisagent selon l'optique traditionnelle d'une forte intervention de l'État dans l'économie. Nous vivons à une époque turbulente de notre histoire, alors que la rapidité des progrès technologiques brave les efforts centralisés pour quantifier, régir et réglementer tout ce qui se passe autour de nous. Tout comme les ordinateurs de 1ère génération, avant l'invention des microcircuits, notre politique économique d'il y a seulement dix ans semble démesurée, presque paralytique, et tout à fait malcommode.

Les anciennes méthodes de réglementation directe de l'économie et d'octroi de subventions à affection déterminée deviennent rapidement périmées, car elles ne peuvent suivre le rythme de la mutation technologique. Les services de renseignements techniques ne devraient plus relever de la compétence des banques de données centralisées. Les mécanismes sclérosés qui devraient encourager l'innovation et la formation technique deviennent inefficaces, et ne répondent plus aux besoins de la société. L'attribution d'une aide directe de l'État aux industries de pointe prend presque autant de temps que la période d'acceptabilité commerciale du produit que le programme de subvention doit aider à développer.

La Politique économique de l'État, pour mettre en relief les possibilités commerciales ouvertes par la technologie nouvelle et en tirer le maximum de bénéfices, doit copier les aspects décentralisateurs et libérateurs de cette même technologie.

En fait les lignes d'action à suivre sont très simples:

1. L'État doit préparer la collectivité à la prééminence de l'esprit d'entreprise.

2. Les autorités publiques doivent encourager la constitution de réseaux sectoriels d'aide réciproque et la prise individuelle

des décisions plutôt que d'imposer un programme ou un plan centralisé pour le développement de l'économie.

3. Enfin, et c'est peut-être ce qui est plus important, les autorités publiques doivent avoir le courage de reconnaître les aspects divers du manque d'à-propos de leur action, et résister à la tentation d'organiser centralement la décentralisation de l'économie, qui commence à se manifester. Cependant, les autorités publiques peuvent faciliter le processus d'adaptation en favorisant l'esprit d'entreprise et la création d'industries, et en mettant en place les conditions favorables à l'innovation et à la croissance de l'économie.

INNOVATION, TECHNOLOGY TRANSFER

AND

SMALL BUSINESS DEVELOPMENT

Presented

by

THE CANADIAN FEDERATION OF INDEPENDENT BUSINESS

to

THE NATIONAL FORUM ON NATIONAL SCIENCE AND TECHNOLOGY POLICY

Winnipeg, Manitoba

June 1986

INNOVATION, TECHNOLOGY TRANSFER AND SMALL BUSINESS DEVELOPMENT

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INTRODUCTION

Most general discussion on the development of small business in Canada usually centres on the broad issues of small business policy -- i.e. financing, management, taxation, and regulation. A comprehensive approach to the development of small business requires that significant attention must also be paid to the issues of new technology development and transfer to the small business sector. New technologies have opened up unrivalled opportunities for increased small business competitiveness. They have helped to decentralize production, facilitate smaller-scale output, streamline marketing and reduce the administrative burden. Small business in Canada stands to be a major beneficiary of overall economic productivity through transfer and adaptation of new technologies.

The competitive advantages of using new technologies have not gone unnoticed by independent business men and women all across our country. In a comparative, 11 nation survey conducted by the C.F.I.B. in conjunctions with the International Small Business Congress it was the Canadian business community that ranked higher than all other developed nations in regard to the degree in which they were searching for information on technological changes that could be used in their business.[1] More than two out of every three Canadian businesses (ie. 68.1%) indicated that they were actively persuing the introduction of new technology into their business, either by making specific inquiries or undertaking actual changes. This degree of interest in technology transfer exceeded the levels recorded by similar business surveyed in such other nations as the United Kingdom, the Netherlands, and even the

1 Thomson, Pat (C.F.I.B.). April 30, 1986. "Small Business: Canada's Engine of Economic Change and Growth" in Proceedings of the fourth Canadian Conference of the International Council for Small Business, Calgary, May 7-9, 1986.

most commonly thought of technological societies such as West Germany, Japan and the United States. A major challenge for public policy makers in this country is therefore to develop new creative mechanisms of technology transfer to feed the vococious appetite of Canadian small business.

In addition to being important users of new technology, small business in Canada also has a major role in the research, development and production of new technology in the rapidly evolving high-tech manufacturing sector. One detailed study in the U.K. showed that small firms contributed about double their share of commercially innovative new products compared to their share of total private sector R.& D. expenditures.[1] The owner-manager in a small enterprise is typically free from the restraint of having to persuade others that his innovation is worth making, and ease of internal communication makes the small firm potentially fast and flexible in responding to changes in demand and technology. Also, the risk to reward ratio often favours the owner-manager as opposed to the salaried manager of a larger firm.

More recent studies further underline these small firm advantages. Based on a survey of American R. & D. companies, small firms take 27% less time to complete the R. & D. cycle - from initial research and design to bringing the product to market. Small R.& D. companies also have 2.5 times as many innovations per employee as large R. & D. firms.[2] Due to these many entrepeneurial advantages several large corporations are now attempting to emulate small business and reorganize new product development into smaller, semi-autonomous work units.

1 Freeman, C., 1971, The Role of Small Firms in Innovation in the U.K. Since 1945, Committee of Inquiry on Small Firms, Research Report No. 6, HMSO.

2 Gellmann Research Associates Inc. 1982.

The purpose of this paper is to examine both of these aspects of technology transfer -- direct innovation by small business in development and transfer of new technology to the market place, as well as the adoption and transfer of these new technologies to improve productivity throughout all sectors of the small business community. Emphasis will be placed on institutional barriers to technology transfer, and on new policy directions to promote increased knowledge, competitiveness and prosperity in the small business economy. Our analysis will also be guided by two fundamental principles which have been stated repeatedly by the CFIB in other briefs and submissions:

1. Governments in Canada should minimize their role as direct economic players or benign "custodians" of small business, and move toward indirect economic policies that allow businesses to grow and prosper in a decentralized process of entrepreneurial decision-making; and

2. Governments must develop economic policies that will encourage multi-dimensional, non-institutional and local activity within the networks of individual competitors, suppliers, friends, families, advisers, bankers and associations which small business operate.

These principles of flexible and decentralized economic growth are especially critical in regard to technology transfer, as no central government authority could ever purport to fully comprehend, let alone plan and direct, the veritable "explosion" of technological change that is currently taking place.

PART 1 - TECHNOLOGY TRANSFER
AND
SMALL BUSINESS PRODUCTIVITY

Independent small business faces numerous obstacles in acquiring modern technology. This is principally due to the struggle to retain sufficient earnings for investment in new technology, and because their very "independence" often prevents proper access to information on new technological problems, or to even recognize the existence of a potential problem due to antiquated technical processes and equipment.

In order to overcome these barriers, several strategies are proposed to help the small and medium-sized business sector recognize, acquire or adopt new technology. We believe that increased productivity through technology transfer can only be realized by improving the overall climate for small business financing and new capital investment. It is also necessary to improve access by small business to market information and technological expertise. More specific suggestions are offered in the following sections.

A. Improving the Climate for Investment in New Technology

We beleive that the first basic factor in being able to modernize and purchase new technology is to allow business to retain sufficient earnings to permit such expenditures. The number one problem voiced by small business in Canada today is the total tax burden imposed by federal, provincial and municipal governments and its impact on reducing these retained earnings. In addition, the growth of property taxes and payroll taxes -- such as Workers' Compensation, Unemplyment Insurance, and Canada Pension Plan premiums -- penalize the increased use of labour whether or not a profit is realized, and add significantly to the difficulty of finding sufficient net profits for business to invest in the new technological revolution.

Additional capital for new technology investment should also be made available through access to increased equity, either through the personal savings of the owners, families and friends, or through "outside" sources of equity such as venture capital or small business development corporations. Capital to finance small business modernization and tech-transfer, like other types of capital, has unfortunately been limited to such sources as debt financing institutions, venture capital firms, or the stock market. Until very recently there has been insufficient effort made by governments to influence the redirection of the savings of **individuals** into small business. Changes made in the 1985 Federal budget represent a positive step toward increasing individual investment in small business through use of RRSP's. More equity financing could be encouraged by loosening the "arms length" restrictions or various venture capital and RRSP sources, as well as broadening the provisions for flow through of capital losses to small business investors.

A third source of money for investing in new technology could come from loan financing. Several other countries have used their national banking institutions as their prime mechanism to encourage technology transfer and modernization of small business. For example, special fixed rate, low interest loans are exclusively targetted for small business modernization and acquisition of new technology through Korea's Small and Medium Bank and West Germany's new "Technology Programme".

In summary, to improve the overall climate for investment in new technology we recommend that governments:

1. Continually reduce the burden of corporate taxation, primarily by redirecting funds away from government assistance in the form of grants and subsidies to business and applying these budget savings toward more tax credits and tax reductions to business;

2. Fundamentally reform Worker's Compensation and Unemployment Insurance, and reduce payroll taxes;

3. Co-operate to encourage the establishment of Small Business Venture Capital vehicles;

4. Allow the flow through of losses to shareholders of private corporations, similar to provisions available in the U.S.A.; and

5. Provide continuous forms of new competition to the major chartered banks, similar to low interest loan programs for tech transfer available in Korea, West Germany and Japan.

B. Access to Manpower

The best way to transfer technology is by the interchange of people with the technological "know-how" to small business employment. **Moving people moves ideas.** Increased technical manpower can be acquired by direct recruitment of full or part-time staff, or through retraining of existing employees.

A very inexpensive way to obtain technical staff is through participation in Co-op Work Study Programs with undergraduate science and engineering students at nearby Universities and technical institutes. More of these programs should be encouraged, for they provide the dual benefit of excellent on-the-job training for students as well as a low-cost, temporary source of expertise by small business.

Similar schemes exist at a graduate level in the U.K., through the British Teaching Company Scheme. It is a partnership between an academic institution and a private enterprise, with the aim of achieving a substantial and comprehensive change in manufacturing -- essentially a technology transfer. The University picks a high calibre

graduate who will spend two years with the company working on the planned change. The academic institution considers providing some appropriate tuition, and advises the student in connection with the work on the program of technology changes. The student normally gets a Master's degree or Ph.D. at the end of the program, as well as a modest salary for the duration of his or her graduate work. The small business or company derives the benefit of added expertise, plus a solution to its technical problems. This model deserves to be examined more closely in Canada, as well as further expansion of various industry-sponsored teaching chairs of Industrial Research, to create a nuclei of graduate students interacting with the local business community through the leadership of business-oriented faculty.

Other employment-related options include programs of executive interchange between business and university or government, targetted wage subsidy programs to encourage hiring of technical student manpower or industrial research fellowships, such as those offered by the National Sciences and Engineering Research Council (NSERC). However, there are many significant barriers to university and/or government interchange with small business, including a significant wage and benefits gap, a lack of portability of public pension plans, a narrow definition of university sabbaticals, and a "publish or perish syndrome" which puts peer pressure on university faculty to conduct basic research rather than apply their skills to helping local business enterprise.

If the small business employer is not in the position of hiring a new employee, he has the option of re-training himself and his other existing staff to keep up with current technological change. But the concept of any prolonged student leave for managers or employees of small firms is totally impractical. Therefore governments have a major role in providing adequate part-time and night-time extension programs to help upgrade technical skills without causing disruption to normal business hours.

In summary, to improve technology transfer through increased exchange of manpower and retraining it is recommended that

1. Governments and Universities work together to promote more Cooperative Work Study Programs at the undergraduate university level, as well as develop post-graduate work study programs similar to the British Teaching Company Scheme or more business-oriented teaching chairs for industrial research.

2. Governments and University administrators reduce the considerable gap in wages and salaries between private and public sector research employees;

3. Universities broaden the eligibility of sabbatical years and reduce the pressure to "publish or perish" in order to allow faculty more time to perform less theoretical research on behalf of the small business community; and

4. Governments and universities ~~provide~~ flexible retraining programs for part-time students and business managers.

C. <u>Access to Technical Information and Research Expertise</u>

Excellent data banks exist throughout Canada on the application of new technology, emerging R. & D., and new technology products and processes. Examples include NRC's Technical Information Service (TIS), the Canada Patent Office, and the Canadian Institute for Scientific and Technical Information (CISTI). However, due to the centralization of these data banks, much of this information is not readily available to small business, nor is it always summarized and indexed in a manner that can be easily retrieved.

More importantly, most of this new technology information is collected by government agencies and "pushed" out at the private sector rather than "pulled" by any pre-determined market interest or business consultation on data bank design.

To correct these deficiencies in passing new technology information on to business, government departments and research agencies are now appointing "information brokers" who will be responsible for spotting useful technology in the field of their specialty. For example, the Industrial Development Office of NRC has proposed the concept of Consulting Innovation Managers (CIM's) or private consultants subsidized by government to specialize in working on technology transfer, as well as assist in obtaining government grants and venture capital.

While these government-run information services may be of benefit to a few firms, it is the general opinion of our membership that goverment agencies are <u>not</u> the most relied upon sources for business information. Rather than creating new public information monopolies, we would encourage the natural development of a new <u>private</u> industry of technological information service and brokerage, forcing greater business sensitivity and efficiency through fee-for-service transactions. Prolonged subsidy of government-sponsored information brokers creates unfair competition with similar services which could otherwise flourish in the private engineering consulting market or among private management consultants. Eventually government-run technological counselling services must be phased out, so that a new high tech service industry has the room to compete freely on an equal basis.

Where the cost of this new private information brokerage service is prohibitive for certain small firms, increased "self-help" in technology transfer should be encouraged through a cooperative relationship within existing trade association. Unfortunately, past conflict between the private sector and governments has pushed trade associations into the role of "political activists" at the expense of their natural role of member development. This industrial self-help approach to technology transfer is used widely in other countries, such as the Local Enterprise Trusts and new "Alvey Clubs" being established in Great Britian. Elsewhere (eg. Japan) the chartered banks, export

trading corporations and other financial institutions have inherited the role of providing technology information services through their grass-roots network of local banking services.

No discussion of technical information transfer would be complete without further mention of the value of extensive government procurement as a vehicle for developing management expertise to the small business community. For example, the Co-Op Tech program of NRC and other federal departments provide an excellent opportunity for tech-transfer "on the hoof" by allowing small business subcontractors to actually work inside public laboratories and be exposed to new facilities and equipment. Private sector sub-contracting is heavily recognized as the prime mechanism for technology transfer in Korea and Japan, with large companies asked to furnish appropriate technological and managerial "know-how" to small firms as part of established liaison arrangements. Small business becomes well suited to the production of specialized parts, with larger firms specializing in assembly of end products. Technology transfer through procurement is also widely recognized in the U.S., primarily through passage of the <u>Small Business Innovation Development Act</u> of 1982. This Act requires all federal agencies to increase small business R & D participation, either directly or through the purchases of prime contractors, by simplifying R & D paperwork and establishing small business R & D goals.

In addition to the domestic transfer of technological information, the role of foreign, multi-national transfers of technology should not be ignored. This "invisible" importation of R & D may even be more considerable than the R & D undertaken by the whole of Canada's manufacturing industry. Agents of Investment Canada, Foreign Trade Commissioners, and Science Counsellors should attempt to rationalize and co-ordinate their foreign investment activities, and try to promote Canada as a good place to put foreign technology to work. In addition, we would encourage more interaction between these foreign "technology

scouts" and indigenous small businesses, including increased transfer of information from Investment Canada and External Affairs to local trade and business association.

Finally, some comment must be made on the role of technology Centres in the tech-transfer process. There are now more than 300 such Centres in place across Canada, providing various industrial extension and research contracting services. However many of these centres were developed on the basis of insufficient market analysis, and are not being utilized as much as first planned. Prior to any further expenditure of tax revenue on more of these Centres, governments should first attempt to better coordinate the current network that is in place, and remove all parochial barriers to full regional or national access. Work through these new Centres should also be made more market-driven and accountable to industry on a full-cost recovery basis. No additional Centres or infrastructure should be planned without the strong interest and support of local business in fulfilling their needs.

In many cases, existing universities and Provincial Research Organizations (PRO's) can provide all the same services that these various Centres do, without establishing any new formal structures. Universities and provincial research organizations must do a better job or marketing their research and technical facilities, and facilitate easier access by local business to this available expertise. Perhaps increased fiscal restraint on the part of senior governments will serve to provoke more aggressive "intra-preneurship" within public research institutes and universities, and more aggressive pursuit of these linkages with the local business community.

In summary, we recommend that governments:

1. Decentralize and simplify technology information data banks such as TIS and CISTI, similar to information networks available in the U.S. under NASA or the American NTIS.

2. Refrain from monopolizing a new service sector for technology information, and promote the role of "information broker" of new technologies through private sector fee-for-services, or information networks in export trading corporations and banks.

3. Where the cost of obtaining information on new technology exceeds the capability of small firms, encourage "self-help" in technology transfer through existing trade associations.

4. Recognize subcontracting from the public and private sector as a prime vehicle for facilitating technology transfer and management expertise to the small business community.

5. Establish annual targets for increasing the small business share of government research contracts, similar to the U.S. Small Business Innovation Development Act.

6. Actively promote technology transfer through foreign investment, and the diffusion of foreign technologies to Canadian small business firms.

7. Improve the coordination of existing Technology Centres, and remove barriers to inter-provincial access.

8. Improve the accountability and relevance of Tech-transfer Centres to business by imposing fee-for-service transaction charges.

9. Facilitate easier access to technical and research expertise in provincial research organizations and universities by encouraging the development of central Offices of University Research or more Industrial Research Liaison Officers to inventory, aggressively market and help manage research services for small business.

PART II - INNOVATION THROUGH SMALL BUSINESS

Frequent discussions on science, technology, and economic development all too often dwell upon the need to increase R. & D. expenditure in Canada relative to our Gross Domestic Product. It is true that Canada's gross industrial expenditure on research and development (GERD) as a percentage of GDP ranks a dismal 12th behind other industrialized nations, such as Germany, Sweden, Japan, France and even the Netherlands. However, CFIB views this apparent gap in research intensity as largely a function of differences in industrial structure, due to the resource-based economy of Canada compared to countries with a large manufacturing sector more inclined to perform R. & D. Comparing the relative proportion of R. & D. funded only by government, Canada's relative standing is considerably improved, and we are in fact tied with the Japanese.[1]

For these reasons, we feel that too much attention has been placed on the need to increase R. & D. in Canada, compared to the "real issue" which is the commercialization of research which has already been completed. A far more serious statistic is the very large and growing trade deficit that Canada suffers in technology-based goods and services.

On the eve of our entry into a new "Global Information Economy", Canada sits with a technology trade deficit of about $12 billion growing at a rate of about 20 per cent per year. If the current trend continues, our national trade deficit could exceed $100 billion per year by the end of the century. The "technology crisis" of the 1990's may parallel our domestic auto-manufacturing crisis of the 1950's or the energy crisis of a few years ago.

1 From the M.O.S.S.T. Background Paper for the National Forum on a National Science and Technology Policy - Appendix A, Major Indications of Canada's Science and Technology Activity.

In response to this growing problem, the CFIB staunchly believes that a new science policy for the country must focus more on entrepreneurship and commericalization of research, rather than simply more R & D. We may already have more technology than we know how to exploit. The creation and development of new technology products and technology-related services from small business are ultimately the only means of keeping Canada competitive and economically independent in this New Technology Age.

To catch up with this changing world economy, we must also encourage new entrepreneurship at a rate unsurpassed in recent Canadian history. We must create new technology-related small business through policy changes that permit the same pioneering spirit shown by our forefathers in development of new farming units (particularly in Western Canada) at the turn of the century. Our suggested "Homestead Act" for expansion of new technology enterprise is presented in the following sections of this paper.

A. <u>Promoting Scientific Entrepreneurship</u>

As CFIB has previously stated, entrepreneurs are not born, they are made. In regard to entrepreneurship of the high techology community, both governments and universities must make the process of starting a new enterprise more credible for a greater portion of university faculty and government scientists, as well as more socially and financially rewarding. Development of entrepreneurial attitudes could begin in the primary and secondary school system, and be included in the curricula of university science and engineering courses.

Public research organization and government laboratories should also encourage the privatization and contracting out of research services, or the formation of independent registered business subsidiaries. Likewise, more time should be recognized for contractual research by university faculty with business, and the encouragement of entrepreneurial business development by the university research community.

Since the starting point for such new ventures is a new venture business plan that investors can understand, we should reward all government and university scientists for producing such plans as well as (or even in lieu of) technical papers. The new message might be "business plan or perish" instead of "publish or perish" in the post-industrial university environments.

Finally, an essential ingredient to new enterprise development based on university or government-sponsored research is the right to intellectual property and patent rights of individual researchers. In this regard, the policies of Canadian government and university adminstrators are often less flexible than those of their counterparts in the U.S.

Therefore, we recommend that governments and universities:

1. Develop systems of entrepreneurial education in the primary and secondary schools, as well as the teaching of entrepreneurial skills in university science and engineering courses;

2. Establish more flexible and consistent intellectual property rights for inventions produced by researchers working either directly for them, or under sub-contract and

3. Encourage the development of proper business plans and more spin-off establishment of new businesses by faculty and government researchers.

B. Financing Small Business R & D and New Technology Enterprise

The sources of finance for small business innovation can be divided into retained profits, individual investment, bank lending, the venture capital market, and finally, govenment assitance programs. These sources are stated in their most probable order of preference of most small business, and each will be examined in separate detail.

The preferred source of external finance for many small business is personal investment by individuals. Any reduction in the levels of both personal and corporate income tax will improve the availability of funds for more business R & D and product development. Reductions in profit-insensitive payroll taxes, (eg. C.P.P., U.I., Worker's Compensation) are particularily important to help new business start-ups retain more earnings for new product development.

As stated earlier in Part I, equity financing is another key source of small business financing -- especially for fast growing high technology businesses. However, traditional venture capital firms are only interested in financing established growth firms that have the potetial of becoming "share" companies. These traditional "vulture" capitalists therefore tend to restrict their investments in the area of $250,000 and up. Governments can use tax incentives to reduce the risks for making minority equity investments in lesser amounts. Governments should also encourage small business access to other sources of equity capital such as a portion of government pensions funds.

Bank lending to small firms often involves requirements for security or collateral which deter or exclude the owner-manager form this source of finance. The risks associated with lending to back an innovation are even greater than normal. Government's best remedy to help the debt financing of innovative small business is to promote credit quarantee schemes that underwrite such risk.

Our members consistently view direct government assistance as the <u>least</u> favourable option, primarily because of the high compliance costs faced by small business in applying for aid and the slow turn-around on most grant applications. The total effort involved in obtaining information on the "alphabet soup" of research assistance available from governments (IRDP, DIPP, ERDA, PILP, PRAI, IRAP, etc.); deciding which scheme is most appropriate; providing the necessary financial production, and

marketing information; completing the documentation; and negotiating with civil servants administering the scheme all combine to form a very high opportunity cost of time and money for most owner-managed enterprises.

We strongly concur with the additional comments made by the recent Wright Task Force Report on Federal Policies and Programs for Technology Development:

> "Attempting to promote industrial research by subsidizing the private sector is an approach with serious strategic weaknesses, mainly the enticement of industry into bureaucratic traps. It sometimes encourages firms to undertake dubious R & D projects which would be uneconomic without government assistance. It sometimes encourages firms to collect federal money for research they might well have taken anyway. It encourages the growth of bureaucracies whose risk-avoiding propensities militate against successful R & D".

Alternatively, we agree with the Wright Task Force that the preferred approach for financing R & D is to allow more decentralized relief under the tax system, as opposed to specific grants.

Government bureaucrats, anxious to justify their own programs, will still argue that most targetted tax incentives will only benefit those firms in a profit-making situation - hence government hand-outs to fledgling high-tech firms should be continued. In response, we note that the federal 1985 budget proposal for a 100% refundable R & D tax credit should render many existing federal and provincial grant programs ~~among~~ immediately obsolete. A maximum refund will be available up to $200,000/year for small R & D businesses regardless of their net profitability. Few

arguments, therefore remain to justify the complex assortment of overlapping and duplicative R & D grant programs among various government jurisdictions.

In summary, many of our previous recommendations for financing technology transfer apply equally to encouragement of R & D in the innovative small business sector. (See **Part 1** - Section B of this Paper).

In addition, **we recommend** that governments abandon almost all forms of direct R & D grants and product development assistance to business, and use the savings earned from these program cuts to fund a decentralized and simplified system of income tax incentives, or generally reduce the business tax environment. These simplified tax incentives should include:

1. refundable tax credits to encourage innovation by small business unable to take advantage of taxable income exemptions;

2. tax credits and other income tax deductions for eligible R & D, prototype development, product testing and market research; and

3. additional tax credits or exemptions to equity investors in new technology enterprise.

C. OTHER CONSIDERATIONS

Other barriers to innovation by small business include skill shortage, basic defects in the ability of the educational system to provide adequately trained graduates, and the difficulty of enticing highly paid government scientists and comfortable university researchers into small private firms. Each of these issues has been discussed previously in Part 1 of this paper.

Also worth repeating is the need for more creative and concerted efforts toward increased government purchasing of small business innovations. We agree with other commentators (eg. Wright Task Force Report), that "a system which involves present and prospective contractors in the development of specifications, and which funds R & D programs well in advance of the time the resultant products will be needed, will be of immeasurable benefit."

Increased latitude for innovation by government sub-contractors would also exist if more contracts were based on flexible specifications of performance, rather than rigid specifications of exact material and design. There is a positive role for government as the "pilot customer" or first user of new technology products.

Finally, innovation through small business is also deterred by the heavy burden of having to deal with regulatory legislation and government red tape. Virtually all legislation is primarily drafted with larger firms in mind, and the "opportunity cost" of owner-managers having to deal with the regulatory paperburden takes away his/her time and energies from other innovation activities.

In addition to these administrative costs of regulatory compliance, many environmental, health and safety regulations are also rigidly prescriptive in forcing very specific industrial product and process

designs. This strict regulatory regime often precludes the introduction of innovative new technologies by business, even though the new product or industrial process may equal or excell beyond all existing performance criteria.

In addition to the previous recommendations made in **Part 1** of this Paper, **we therefore further recommend** that governments:

1. Prepare longer term plans of purchasing requirements and give small business contracting companies additional time to develop and market their innovations.

2. Encourage more product development by sub-contractors based on flexible performance, rather than rigid design specifications;

3. Audit the costs in terms of time and money for small firms to comply with government regulations, red tape, and paperburden during the early start-up period of operation; and take appropriate action to reduce or simplify these onerous requirements;

4. Reduce all unnecessary regidities in environmental, health, and public safety regulations to allow more latitude for new product and process innovations; and

5. Screen all new regulations and legislation before going to Cabinet for their potential harmful impact on small business and their potential to unfairly stifle industrial innovation.

CONCLUSIONS

At first glance, analysis of ways and means to improve technology transfer and innovation through Canada's small business community appears to be a very formidable task. At last count there were at least 57 different agencies involved in science and technology expenditures at just the federal level alone. Over 300 new technology "centres" are now scattered across Canada from coast to coast. Numerous other provincial programs and technology transfer services are evolving rapidly, almost on a monthly basis.

Yet Canada continues to lag behind most other industrialized nations in export of modern technology and technological innovation. Why should so much government attention yield such frustrating results?

Viewed from the traditional perspective of strong government intervention in the economy, it is little wonder that the process of technological innovation seems so mystifying. We are moving through a turbulant era in history in which the rate of technological change defies all attempts to centrally quantify, regulate and control everything that is happening around us. Like the "primitive" computers before the microchip, our economic policies of even just ten years ago now seem very big, very slow, and awkwardly out of place.

In order to keep pace with this technological revolution, old methods of direct economic regulation and targetted subsidies are fast becoming obsolete.

Technology information services need no longer remain the purview of remote central government repositories.

Structural "monuments" to encourage innovation and training are becoming hopelessly out-dated and unresponsive to current societal needs.

Direct government R & D assistance to high tech business can take almost as long to deliver as the entire commerical lifetime of the new products that these programs are designed to help develop.

Therefore to fully understand and maximize the economic opportunities caused by this techological revolution, government economic policies must try to mimic the decentralizing and liberating features of this new technology itself.

The rules of the new economy are really quite simple:

1. Government must help prepare society for the age of the entrepreneur.

2. Government must encourage more self-help, group networks and individual decision-making rather than the influence of a central economic program or plan.

3. Lastly, and perhaps most important of all, governments must have the courage to recognize the many elements of their own obsolescence, and resist the temptation to centrally plan the new decentralized economy that is emerging. Governments, however, can facilitate the process of adjustment by supporting entrepreneurship, new venture formation and a positive business climate for innovation and growth.

CANADIAN LABOUR CONGRESS CONGRES DU TRAVAIL DU CANADA

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SUMMARY

OF

DISCUSSION PAPER

PREPARED FOR THE

NATIONAL FORUM ON A

NATIONAL SCIENCE AND TECHNOLOGY POLICY

WINNIPEG, JUNE 1986

The Canadian Labour Congress, which represents over 2 million workers, believes that economic policies must be built on full employment and fairness. A National Science and Technology Policy should reflect these two premises and be developed within the context of national economic initiatives.

A free trade agreement with the United States will not provide economic solutions for our science and technology challenges. In negotiating a comprehensive free trade agreement with the U.S., a wide range of economic management tools will be challenged by the Americans on the grounds that they are non-tariff barriers to trade. Regional development grants, agricultural support programs, subsidies to technology industries and government procurement programs may all be challenged. In other words, the tools of national economic management will be on the negotiating table. If we want to use grants and public investment to overcome regional economic disparities or diversify manufacturing bases we will have to get U.S. agreement that these measures do not involve non-tariff barriers to trade. If we want to use grants and regulations to preserve Canadian ownership in the communications industry and ensure the vitality of Canadian industries we will also need U.S. agreement that such measures do not involve non-tariff barriers to trade. In short, a comprehensive free trade agreement with the U.S. will limit Canada's scope for effective and independent political action to address economic issues especially in the area of science and technology.

The background paper refers to privatization and contracting-out to promote an increase in science and technology activity. The Canadian labour movement has consistently opposed privatization and contracting-out as policies that operate against the interests of working people.

Public sector employment can and should be used as a model to implement public policy objectives such as affirmative action including pay equity, bilingualism and regional development. Contracting-out means that the scope for implementing such policies will be reduced -- another example of the abandonment of an important tool of public policy.

In the context of Canada's current high rate of unemployment, privatization and contracting-out should not be considered if they will result in job loss. Nor should they be considered if their effect will threaten wage and salary levels. To ignore or deny the interests of workers in considering these issues is public policy at its worst.

Government and industry tell us technological change is inevitable -- without it Canadian industry will become uncompetitive and our whole economy will suffer. Technological change which simply increases profits by displacing workers does not strengthen the Canadian economy. We are already experiencing the problems associated with unequal distribution of wealth and income in the country. While over a million Canadians are unemployed, Canadian corporations invest record-high profits not in the creation of new enterprises but in the manipulation of stock portfolios. The burden of tax continues to shift away from corporations toward individuals. In such circumstances we cannot afford to add thousands of Canadians to the unemployment lines.

It is in the interests of workers, employers and governments that technological change be introduced in the workplace in a smooth, non-disruptive manner with a minimum of adverse impacts. For this to happen there must be a commitment to share the costs and benefits equitably.

The collective bargaining process is the most effective method of sharing costs and benefits. In order to operate efficiently, collective bargaining requires a legislative framework. Labour legislation in all jurisdictions should be amended to provide minimum standards including: a comprehensive definition of technological change to minimize exemptions; one year advance notice of change; full disclosure of information; mandatory consultation between the two parties with no change introduced until an agreement is reached.

The improved productivity generated by technological change should be shared both at the workplace and in the economy in general through a system of shorter work time.

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The C.L.C. advocates a national science and technology policy, based on full employment and fairness both in its direction and content. That is, the goal of research and development should be socially useful, its benefits shared throughout the economy. Policies like privatization and contracting-out should not be implemented in the pursuit of research and development because of their negative impact on employment and working conditions.

We are pleased to see the Ministry of State for Science and Technology bring together the partners in this debate. We hope this will continue. Participation by the partners involved, both in the workplace and at the policy making level will ensure a smoother introduction of technology and ensure society as a whole shares in its benefits.

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CANADIAN LABOUR CONGRESS CONGRES DU TRAVAIL DU CANADA

DISCUSSION PAPER

Prepared for the

National Forum on a National Science and Technology Policy

Winnipeg, June 1986

Canada is currently facing major economic challenges. The decisions made now will determine what kind of society exists in the future. The Canadian Labour Congress, which represents over 2 million workers, believes that economic policies must be built on full employment and fairness. They must focus on creating jobs, promoting socially useful investment and raising living standards. It is from this perspective that we participate in this discussion of a National Science and Technology Policy. This discussion paper will present our views on the directions such a national policy should take in the context of the Government's background paper "Building on Our Strengths".

1. **Developing and Acquiring New Knowledge**

The background paper raises the issue of the lack of research functions in the majority of Canadian universities. This situation is not surprising given the trend in governments' policies toward educational institutions in recent years. The erosion of government funding to universities has meant a reduction in their ability to fund research. The decline in provincial support for universities is directly related to the cutbacks in federal/provincial transfer payments.

In our brief to the Finance, Trade and Economic Affairs Committee which was deliberating proposed cutbacks in federal/provincial fiscal arrangements in 1982, we recommended that Established Programs Financing support for post-secondary education should be specifically designated for that purpose. Such a recommendation would have alleviated the problem of provinces reallocating the funds for other purposes and ensure universities would continue to receive the funding needed to continue/establish adequate research programs. A National Science and Technology Policy should re-examine this recommendation as a solution to the lack of technology research programs in post-secondary institutions.

Recent years have seen the establishment of technology centres across the country. As the background paper states their role is to "service the needs of industry". While the paper raises the issues of

size and fragmentation, from our perspective there is a much larger problem. These centres, many of which are funded with taxpayers' dollars, are oriented towards the needs of business in the introduction of technology. With the exception of the Manitoba Workplace Innovation Centre which has a joint labour/business board, there is no representation from labour on the boards nor participation by labour in the identification of projects or priorities. It is clear that workers will be directly and indirectly (through labour market changes) be affected by the introduction of technology, it is inexcusable that labour is not allowed participation in these centres so that workers needs are also "serviced". We would recommend that a National Science and Technology Policy address this issue.

2. **Putting Knowledge to Work**

A free trade agreement with the United States will not provide economic solutions for our science and technology challenges. In negotiating a comprehensive free trade agreement with the U.S., a wide range of economic management tools will be challenged by the Americans on the grounds that they are non-tariff barriers to trade. Regional development grants, agricultural support programs, subsidies to technology industries and government procurement programs may all be challenged. In other words, the tools of national economic management will be on the negotiating table. If we want to use grants and public investment to overcome regional economic disparities or diversify manufacturing bases we will have to get U.S. agreement that these measures do not involve non-tariff barriers to trade. If we want to use grants and regulations to preserve Canadian ownership in the communications industry and ensure the vitality of Canadian industries we will also need U.S. agreement that such measures do not involve non-tariff barriers to trade. In short, a comprehensive free trade agreement with the U.S. will limit Canada's scope for effective and independent political action to address economic issues especially in the area of science and technology.

Public opinion continues to identify "jobs" as the key economic issue. Yet on this issue free trade promises to be a disaster. Substantial short-term job losses are virtually guaranteed in a number of industrial sectors such as: brewing, home appliance manufacture, petro-chemicals, food processing and clothing and textiles. The government of Canada has refused to make public its studies on the economic impact of free trade. However an Ontario government study has estimated 281,000 manufacturing jobs are vulnerable under a free trade pact. A Quebec government study suggests that 450,000 jobs may be lost in that province alone.

Trade policy, like all economic policies, must be recognized as an important part of an economic policy that is designed to provide full employment, a rising standard of living for all Canadians and a more equitable distribution of income and wealth.

An economic strategy designed to meet these objectives must address the problem of lack of strength and diversity of the Canadian manufacturing sector. It must strengthen domestic industries and markets through such mechanisms as: Canadian content rules; import replacement programs; domestic procurement programs of government and Crown corporations; industrial offset programs and measures to increase industrial research and development.

The background paper refers to privatization and contracting-out to promote an increase in science and technology activity. The Canadian labour movement has consistently opposed privatization and contracting-out as policies that operate against the interests of working people.

Public sector employment can and should be used as a model to implement public policy objectives such as affirmative action including pay equity, bilingualism and regional development. Contracting-out means that the scope for implementing such policies will be reduced -- another example of the abandonment of an important tool of public policy.

The provision of cheaper services by the private sector may have little to do with the comparative efficiency of the private sector but may be directly related to the fact that the private sector can avoid a unionized

workforce. Numerous studies have indicated that contracted-out work may in fact cost more but in ways that are hidden or "compartmentalized" to appear cheaper. There are no guarantees that the quality of work will not be sacrificed in the quest for profit. As well the accountability of governments for the quality of work may be lost. In the area of science and technology these concerns are particularly significant. Also the fact that the private sector's record on research and development, as shown in the government's background paper, has been historically very poor.

We would support a review of existing federal facilities conducting Research and Development to examine their efficiency and direction, but not the privatization of these projects for reasons already stated.

In the context of Canada's current high rate of unemployment, privatization and contracting-out should not be considered if they will result in job loss. Nor should they be considered if their effect will threaten wage and salary levels. To ignore or deny the interests of workers in considering these issues is public policy at its worst.

3. Managing Change

Technological change is progressing throughout the Canadian economy. The Ontario Task Force on Technology and Employment found that there is already a substantial amount of new technology in place in both the manufacturing and service sectors in Ontario.

Technological change is having a marked effect on the rate of job creation. A public opinion poll commissioned by the C.L.C. and Labour Canada from Decima Research indicated that 62% of those surveyed expected technological change to result in a decline in the number of jobs. The job predictions in the Ontario Task Force Report imply an increase in unemployment from 8% to 11.7% in 1990.

Government and industry tell us that technological change is inevitable -- without it Canadian industry will become uncompetitive in world markets and our economy will suffer.

Technological change which simply increases profits by displacing workers does not strengthen the Canadian economy. We are already experiencing the problems associated with unequal distribution of wealth and income in this country. While over a million Canadians are unemployed, Canadian corporations invest record high profits not in the creation of new enterprises but in mergers and acquisitions which in most cases are non-productive and result in job loss through corporate restructuring. As well, the burden of tax continues to shift away from corporations toward individuals. In such circumstances we cannot afford to add thousands of Canadians to the unemployment lines.

Technological change can be a boon to the economy. The technology itself is neutral, it is the way it is introduced that determines its effects. If technology is to benefit the economy, significant changes are required in attitudes, legislation and public policy.

It is in the interests of workers, employers and governments that technological change be introduced in the workplace in a smooth, non-disruptive manner with a minimum of adverse impacts. For this to happen there must be a commitment to share the costs and benefits equitably.

The collective bargaining process is the most effective method of sharing costs and benefits. In order to operate efficiently, collective bargaining requires a legislative framework. Currently only four jurisdictions in Canada have legislation addressing the issue of technological change -- B.C., Saskatchewan, Manitoba, and the Canada Labour Code. Labour legislation in all jurisdictions should be amended to provide minimum standards on issues like: definition of technological change; advance notice, consultation and retraining. Where public employees are legislatively prohibited from negotiating technological change such limitations should be removed.

An adequate definition of technological change in legislation should clarify what constitutes technological change so that exemptions are minimized. Existing legislative definitions are so weak that exemptions are more prevalent than applications.

Legislated advance notice would allow both parties sufficient time to ensure technological change is introduced with the minimum of adverse effects. Existing legislation is inadequate with regard to advance notice provisions. An appropriate notice period would vary by industry, however, at least one year is required. Public opinion supports the concept of advance notice. Our poll indicated that 74% of those surveyed supported advance notice and of those 74% indicated notice of 6-18 months was required. Without a sufficient notice period there can be no effective discussion between the parties.

Labour legislation should be amended to require full disclosure of information and consultation with workers on the introduction of technologica change. The range of items subject to negotiations should be spelled out and include: equipment design, method of introduction, design of affected jobs, classification and pay, retraining, transfer, income guarantees, method of lay-off if job loss is agreed to, and termination payments.

Technological change will impose additional strains on an already inadequate training system. As change progresses and accelerates, the need for training will become a recurrent one. A system of paid education leave would address this need.

In order to finance training needs a new system is required: one which incorporates the planning needed to address skill shortages; one which ensures equal participation among employers in the financing and one which guarantees the full range of skills associated with a job are taught to ensure labour market flexibility. The C.L.C. has long been advocating a grant-levy system to finance training. Sectoral committees made up of industry, labour and government representatives would study anticipated training needs. A levy would be assessed on all firms within the sector to finance training and grants would be given to firms conducting training schemes approved by the sectoral committees.

Special attention will have to be paid to the training needs of women, who tend to be employed in areas such as clerical, sales and service which will be increasingly targets of technological change.

Health and safety standards must accompany the introduction of technological change to ensure workers protection. More research is required into long term radiation effects ergonomics and stress in order to establish minimum legislated standards.

The improved productivity brought about by tech change should be shared through a system of shorter work time. Over 66% of those surveyed in our poll thought workers should share in the productivity gains made possible by technology. Opinion was evenly split between those who advocated less time for the same pay or more pay for the same work hours, depending on occupation and regional breakdowns.

A legislative framework incorporating minimum standards and guaranteed participation would improve the consultative process between employers and workers and enable the sharing of the costs and benefits of technological change.

4. Putting a National Science and Technology Strategy to Work

A National Science and Technology Policy cannot be developed in isolation. It must be co-ordinated as part of an economic strategy to address the issues of jobs, training and distribution of wealth.

We are pleased to see the Ministry of State for Science and Technology taking the initiative to bring together the partners in this debate -- business, labour, government and academia. We hope this will continue. But we must voice our concern that in order for consultation to be meaningful, parties must be listened to, not just heard.

The Canadian Labour Congress advocates economic planning with a focus on creating jobs, promoting social useful investment, a fair distribution of wealth and income, adequate public services and equality. It will be in this context that we participate in a discussion of economic policy and it will be in this context that we will assess government's policy initiatives.

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Congrès du travail du Canada

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CONFÉRENCE SUR LA POLITIQUE NATIONALE
DES SCIENCES ET DE LA TECHNOLOGIE

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SOMMAIRE

Le Congrès du travail du Canada, qui représente plus de deux millions de travailleurs, estime que toute politique économique doit être fondée sur le plein emploi et l'équité. La Politique nationale des sciences et de la technologie devrait tenir compte de ces deux nécessités, et s'insérer dans le cadre des initiatives économiques à l'échelon national.

La conclusion d'un accord de libre-échange avec les États-Unis ne fournirait aucune solution économique aux défis que les sciences et la technologie nous présentent. Lors des négociations, nos interlocuteurs américains exigeraient que nous renoncions à de nombreux leviers économiques, sous prétexte qu'ils posent des entraves techniques (non-tarifaires) aux échanges. Ils pourraient ainsi contester l'emploi des subventions au développement régional, des programmes de soutien de l'agriculture et des subventions aux industries de pointe, et l'octroi préférentiel des marchés publics. En d'autres mots, les leviers de la gestion de l'économie nationale se trouveraient sur la table des négociations. Si les autorités canadiennes désiraient utiliser l'octroi de subventions et les investissements publics pour remédier aux disparités interrégionales ou diversifier la production industrielle, il leur faudrait convaincre les autorités américaines d'admettre que ces mesures ne constituent pas des entraves techniques aux échanges. Si le gouvernement voulait utiliser les subventions et la réglementation pour préserver l'appartenance canadienne des industries des télécommunications et assurer leur dynamisme, il lui faudrait également convaincre les Américains qu'il ne s'agit pas de barrières non tarifaires. Bref, la conclusion d'un accord de libération complète des échanges avec les États-Unis limiterait effectivement la liberté d'action des autorités politiques en matières économiques, particulièrement sur les plans scientifique et technologique.

L'Étude de documentation estime que la privatisation des établissements de recherches et l'impartition des recherches de l'État permettraient d'accroître les activités scientifiques et technologiques. Soulignons que le Congrès du travail du Canada s'est constamment opposé à une politique de privatisation et d'impartition qui irait à l'encontre des intérêts des travailleurs.

Les règles de l'emploi dans la Fonction publique pourraient et devraient servir de modèle pour la réalisation des objectifs de la politique d'intérêt public comme la discrimination positive, le salaire égal à travail égal, le bilinguisme et le développement régional. La politique d'impartition restreint la latitude de mise en oeuvre de ces politiques, autre exemple d'abandon d'un important levier de la politique de l'État.

En raison du fort taux de chômage dont souffre actuellement le Canada, il ne faudrait pas envisager de privatisation ou d'impartition qui entraînerait des suppressions d'emploi, ou encore qui menacerait le niveau des traitements et des salaires. Ce serait renier son titre que de mener une politique d'intérêt public refusant de prendre en considération les intérêts des travailleurs, ou même s'y opposant.

Les dirigeants politiques et les industriels nous affirment que le changement technologique est inévitable, et que si l'industrie n'adoptait pas les progrès techniques, elle perdrait son pouvoir de concurrence, et donc que l'économie canadienne en souffrirait. Nous estimons que le changement technique qui permettrait simplement d'accroître les bénéfices des entreprises en évinçant les travailleurs ne renforcerait nullement l'économie. Nous souffrons déjà des problèmes causés par une répartition inégale de la richesse et des revenus dans tout le pays. Alors même que plus d'un million de Canadiens se trouvent en chômage, les entreprises canadiennes investissent leurs bénéfices, d'un niveau encore jamais atteint, non pas dans la création d'entreprises nouvelles, mais dans des manoeuvres boursières. Le poids de la

fiscalité passe de plus en plus des sociétés industrielles vers les particuliers. Dans ces circonstances, il n'est pas possible d'ajouter des milliers de chômeurs aux queues des guichets de l'assurance-chômage.

C'est dans l'intérêt des travailleurs, des employeurs et des autorités publiques qu'il faudrait introduire sans hâte ni bouleversement les changements technologiques dans les lieux de travail, de façon à réduire le plus possible les conséquences négatives. Et, dans ce but, il faudrait que les parties intéressées en partagent équitablement les coûts et les avantages.

Le processus de négociation collective constitue la méthode la plus efficace pour obtenir ce partage équitable. Mais pour fonctionner avec succès, il lui faut un cadre législatif. Il faudrait donc amender la législation du travail dans toutes les provinces et territoires, afin d'y inclure des prescriptions minimales, y compris: une description exhaustive du changement technologique, afin de réduire les exemptions au minimum; un préavis d'un an pour tout changement technologique; une divulgation complète des faits; une consultation obligatoire entre les deux parties, et l'interdiction d'introduire le changement technologique avant qu'elles ne se soient mises d'accord à son sujet.

Il faudrait que l'accroissement de productivité rendu possible par le changement technologique soit partagé entre le lieu de travail et l'économie en général, grâce au raccourcissement de la durée du travail.

Le CTC propose que la Politique nationale des sciences et de la technologie, tant par son orientation que par son contenu, vise à atteindre le plein emploi et l'équité. L'objectif de la recherche et du développement technique devrait donc être socialement utile, et il faudrait que les avantages qui en résulteraient soient répartis dans toute l'économie. On ne devrait pas appliquer les politiques de privatisation et d'impartition en cette matière à cause de leurs effets néfastes sur les conditions de travail et d'emploi.

Nous sommes heureux que le Ministre d'État chargé des Sciences et de la Technologie ait réuni les partenaires sociaux pour en débattre. Nous espérons que cet effort continuera. Cette participation de tous les intéressés tant au lieu de travail qu'au palier décisionnel assurerait une mise en oeuvre sans à-coup du changement technologique et un partage équitable de ses avantages au sein de la société.

DOCUMENT DE TRAVAIL

Le Canada fait actuellement face à de graves défis sur le plan économique. Les décisions qui vont être prises détermineront quelle sera la nature de la société canadienne de l'avenir. Le Congrès du travail du Canada, qui représente plus de deux millions de travailleurs, estime que la politique économique doit viser au plein emploi et à l'équité sociale. La création d'emplois, l'encouragement aux investissements socialement utiles et l'élévation du niveau de vie sont les objectifs qu'on doit lui désigner. C'est dans cette perspective que nous participons au débat sur l'élaboration d'une politique nationale des sciences et de la technologie. Dans le présent Document de travail, nous exposons notre opinion sur l'orientation qu'une telle politique devrait prendre, parallèlement à l'Étude de documentation publié par le Ministère d'État: "Les moyens de notre avenir".

1. L'acquisition et le développement des connaissances nouvelles

L'Étude de documentation évoque l'absence d'activités de recherche dans la majorité des universités canadiennes. Cette situation ne doit pas surprendre, si l'on se souvient de la politique de l'État à l'égard des universités au cours de ces dernières années. La réduction en termes réels du financement public de ces établissements a entraîné une réduction de leur capacité de financer la recherche. La diminution de l'aide provinciale découle directement de la compression des versements de péréquation fédéraux aux provinces.

Dans notre mémoire au Comité des finances, du commerce et des affaires économiques, qui étudiait les compressions proposées dans les accords fiscaux fédéraux-provinciaux de 1982, nous avons déclaré que le financement des programmes établis dans l'enseignement post-secondaire devrait leur être réservé explicitement. Cette mesure aurait empêché les autorités provinciales d'employer les fonds à d'autres fins, et assuré aux universités un financement stable leur permettant de poursuivre ou de mettre en oeuvre des programmes de recherches convenables. La Politique

nationale des sciences et de la technologie devrait donner suite à cette recommandation afin de remédier au manque de programmes de recherche technologique dans les établissements d'enseignement post-secondaire.

Au cours de ces dernières années, on a créé des centres de technologie d'un bout à l'autre du pays. Comme le déclare l'Étude de documentation, leur rôle est de "se mettre au service de l'industrie". Alors que ce document évoque les problèmes de taille critique et d'écartèlement des activités, il existe, selon nous, un problème beaucoup plus répandu. Ces centres, dont la plupart sont financés à même les deniers publics, s'efforcent d'aider les entreprises à mettre en oeuvre la technologie nouvelle. Or, à l'exception du Centre d'innovation en lieu de travail du Manitoba, dont le conseil d'administration est formé de membres des syndicats et du patronat, les autres n'ont aucune représentation du monde ouvrier au sein de leur conseil d'administration, et ne prévoient aucune participation des travailleurs au choix des priorités ou des projets à réaliser. Il est évident que les travailleurs sont directement affectés par l'introduction d'une technologie nouvelle, et indirectement aussi par les changements qui se produisent dans le marché du travail. Il est donc inadmissible que les travailleurs n'aient rien à dire sur le fonctionnement de ces centres, et ne puissent exprimer leurs aspirations. Nous recommandons que la Politique nationale des sciences et de la technologie comble cette lacune.

2. L'utilisation des connaissances pour tirer parti des possibilités

La conclusion d'un accord de libre-échange avec les États-Unis ne fournirait aucune solution économique aux défis que les sciences et la technologie nous présentent. Lors des négociations, nos interlocuteurs américains contesteraient tout un éventail de leviers de gestion de l'économie, parce qu'ils constituent des entraves techniques (non tarifaires) aux échanges. Les subventions aux industries de pointe et les programmes d'octroi des marchés publics pourraient tous se trouver contestés. En d'autres mots,

les leviers de gestion économique du pays se trouveraient sur la table des négociations. Si les autorités canadiennes voulaient utiliser les subventions et l'investissement de fonds publics en vue de remédier aux disparités interrégionales ou de diversifier la fabrication industrielle, il leur faudrait convaincre les États-Unis que ces mesures ne constituent pas des barrières non tarifaires aux échanges. Si le gouvernement désirait utiliser les subventions et la réglementation pour protéger l'appartenance canadienne des entreprises de télécommunications et assurer le dynamisme de l'industrie canadienne, il lui faudrait aussi obtenir des États-Unis qu'ils ne considèrent pas ces mesures comme des entraves techniques aux échanges. Bref, la conclusion d'un accord de libre-échange avec les États-Unis limiterait effectivement la latitude d'action politique des autorités canadiennes pour s'occuper des questions économiques, particulièrement dans le domaine des sciences et de la technologie.

L'opinion publique considère toujours l'emploi comme le principal objectif économique. Et pourtant, sur ce plan, le libre-échange ouvre des perspectives désastreuses. Il garantit en pratique des pertes d'emploi à court terme dans un certain nombre de secteurs industriels: brasserie, fabrication des appareils ménagers, pétrochimie, transformation des produits alimentaires, habillement et produits textiles. Le gouvernement du Canada a refusé de rendre publiques les études qu'il avait commandées au sujet des conséquences économiques du libre-échange. Mais une étude réalisée par le gouvernement de l'Ontario a estimé que 281 000 emplois seraient menacés dans l'industrie ontarienne de fabrication et, au Québec, une étude du gouvernement de cette province a montré que 450 000 emplois pourraient y être perdus.

On doit considérer la politique commerciale, telle toute politique économique, comme un facteur important du plein emploi et de l'élévation du niveau de vie pour tous les Canadiens, et d'une répartition plus équitable des revenus et de la prospérité.

La stratégie économique destinée à atteindre ces objectifs doit remédier au manque de dynamisme et de diversification du secteur de fabrication du Canada. Pour renforcer les industries canadiennes et le marché intérieur, elle pourrait mettre en oeuvre des mécanismes tels que: l'exigence d'une valeur ajoutée au Canada; des programmes de substitution des produits importés; l'octroi des marchés publics de l'Administration et des sociétés de la Couronne à des fournisseurs canadiens; des programmes de compensation de l'industrie et des mesures pour développer l'effort de R-D industrielle.

L'Étude de documentation estime que la privatisation et l'impartition des travaux favoriseront le développement de l'activité scientifique et technologique. Mais les syndicats ouvriers canadiens se sont toujours opposés aux politiques de privatisation et d'impartition, car ils estiment qu'elles vont à l'encontre des intérêts des travailleurs.

Les règles de l'emploi dans la Fonction publique pourraient et devraient servir de modèle pour la réalisation des objectifs de la politique d'intérêt public, comme la discrimination positive, le salaire égal à travail égal, le bilinguisme et le développement régional. La politique d'impartition restreint la latitude de mise en oeuvre de ces politiques, autre exemple d'abandon d'un important levier de la politique de l'État.

Il se peut que la fourniture de services meilleur marché par le secteur privé n'ait pas grand-chose à voir avec une plus grande efficacité de ce secteur, mais qu'elle découle plutôt de l'absence de syndicalisation de la main-d'oeuvre de certaines entreprises. De nombreuses études ont d'ailleurs indiqué que les travaux impartis à l'extérieur pourraient en fait entraîner des coûts supérieurs, en partie cachés ou imputés à d'autres postes pour qu'ils paraissent moins élevés. La recherche du profit ne garantit nullement que la qualité du travail ne sera pas sacrifiée. De même, la responsabilité du secteur public pourrait s'évanouir. Ces préoccupations sont particulièrement importantes dans le domaine des sciences et de la technologie. De plus,

comme l'Étude de documentation le souligne, la performance du secteur privé en matière de recherche et de développement technique a été très déficiente dans le passé.

Nous recommandons en conséquence une évaluation approfondie de l'efficacité et de l'orientation des établissement fédéraux accomplissant de la R-D, mais nullement leur privatisation, pour les raisons que nous avons déjà mentionnées.

En raison du fort taux de chômage dont souffre le Canada, il ne faudrait pas envisager de privatisation ou d'impartition des travaux qui entraînerait des suppressions d'emplois, ou encore qui menacerait le niveau des traitements et des salaires. Ce serait renier son titre que de mener une politique d'intérêt public refusant de prendre en considération les intérêts des travailleurs, ou même s'y opposant.

3. <u>La gestion du changement</u>

Les changements technologiques se répandent dans l'économie canadienne. Le Groupe de travail sur la technologie et l'emploi en Ontario a conclu qu'un volume considérable de technologie nouvelle était utilisé dans les secteurs de fabrication et des services de cette province.

L'évolution technologique a une incidence marquée sur le taux de création d'emplois. Un sondage d'opinion commandé par le CTC et Travail Canada à Décima Research a indiqué que 62 pour cent des personnes interrogées croyaient que l'évolution technologique causerait une réduction du nombre des emplois. Le Rapport du Groupe de travail ontarien prévoit que le chômage passerait de 8 pour cent de la population active ontarienne à 11,7 pour cent en 1990.

Les autorités publiques et les chefs d'industrie nous affirment que le changement technologique est inévitable et que, sans lui, l'industrie canadienne perdrait son pouvoir concurrentiel

à l'étranger et l'économie du pays de notre pays péricliterait. Mais le changement technologique qui permettrait simplement d'accroître les bénéfices des entreprises en évinçant les travailleurs ne renforcerait nullement l'économie. Nous souffrons déjà des problèmes causés par une répartition inégale de la richesse et des revenus dans tout le pays. Alors que plus d'un million de Canadiens se trouvent en chômage, les entreprises canadiennes investissent leurs bénéfices, d'une ampleur encore jamais atteinte, non pas dans la création d'entreprises nouvelles, mais dans des fusions et des acquisitions qui, la plupart du temps, ne sont pas productives et entraînent des pertes d'emploi par suite de la réorganisation des sociétés. De même, le poids de la fiscalité passe de plus en plus des sociétés industrielles vers les particuliers. Dans ces circonstances, il n'est pas possible d'ajouter des milliers de chômeurs aux queues des guichets de l'assurance-chômage.

Les changements technologiques pourraient revivifier l'économie. L'évolution technologique est par elle-même neutre; c'est par les changements introduits dans l'industrie qu'elle a des effets. Pour qu'ils soient bénéfiques sur le plan de l'économie, il faudrait que les attitudes des intéressés, la législation et la politique d'intérêt public subissent d'importantes modifications.

C'est dans l'intérêt des travailleurs, des employeurs et des autorités publiques qu'il faudrait introduire sans hâte ni bouleversement les changements technologiques dans le lieu de travail, de façon à en réduire le plus possible les conséquences négatives. Et, dans ce but, il faudrait que les parties intéressées en partagent équitablement les coûts et les avantages.

Le processus de négociation collective constitue la méthode la plus efficace pour obtenir ce partage équitable. Mais pour fonctionner avec succès, il lui faudrait un cadre législatif. Actuellement, trois provinces seulement disposent d'une législation

portant sur le changement technologique: la Colombie-Britannique, la Saskatchewan et le Manitoba, et il faut ajouter le Code du travail du Canada. Il faudrait amender la législation du travail dans toutes les juridictions, afin d'y inclure des prescriptions minimales, y compris: une définition du changement technologique; un préavis d'un an pour tout changement technologique; la consultation obligatoire des intéressés et le recyclage des travailleurs. L'interdiction légale faite aux fonctionnaires de négocier les changements technologiques devrait être rescindée.

Une définition légale suffisante du changement technologique devrait en préciser les traits caractéristiques, afin de réduire les exemptions au minimum. Les définitions légales actuelles sont si imprécises que les exemptions sont plus nombreuses que les assujettissements.

Le préavis obligatoire permettrait aux deux parties de préparer à loisir l'introduction du changement technologique avec le minimum d'effets négatifs. La législation actuelle ne précise guère la durée du préavis, et celle-ci devrait varier selon les caractéristiques des diverses branches industrielles. Un an, au moins, serait nécessaire. Notre sondage indique que 74 pour cent des personnes interrogées sont en faveur du préavis, et que 74 pour cent aussi de ce pourcentage envisageraient une durée de 6 à 18 mois. Il est nécessaire de prescrire un préavis assez long pour que les discussions entre parties puissent être efficaces.

Il faudrait amender la législation du travail pour exiger la divulgation complète des faits et la consultation des travailleurs au sujet du changement prévu. La loi devrait prescrire la gamme des questions à négocier, y compris: la conception des matériels, la méthode d'introduction, la description des emplois concernés, le classement et la paie, le recyclage, la réaffectation, la garantie de ressources, le processus de mise à pied si la perte d'emploi est acceptée et l'indemnité de licencement

L'évolution technologique imposera des tensions supplémentaires à un réseau de formation technique déjà insuffisant. A mesure que cette évolution progressera et s'accélérera, la nécessité du recyclage se reproduira. Un mécanisme de congés payés pour recyclage permettrait d'y remédier.

Il serait nécessaire de mettre en place un nouveau mécanisme de financement de la formation, tenant compte des pénuries prévues de travailleurs en certaines spécialités. Les employeurs devraient participer également au financement de cette formation, laquelle devrait porter sur toutes les compétences techniques requises pour un emploi donné, afin de conférer de la souplesse au marché du travail. Le CTC recommande depuis longtemps un mécanisme de subventions et de prélèvements pour financer la formation des travailleurs. Un prélèvement serait imposé à toutes les entreprises du secteur concerné par cette formation, et des subventions seraient attribuées aux entreprises administrant des programmes de formation approuvés par ces comités sectoriels.

Il faudrait accorder une attention spéciale au besoin de formation des femmes, qui travaillent souvent dans des emplois de bureau, de magasin ou de services qui sont de plus en plus affectés par le changement technologique.

On devrait imposer des normes de sécurité et de salubrité au processus de changement technologique, afin d'assurer la protection des travailleurs. En vue d'élaborer les normes minimales légales, il faudrait accomplir des recherches sur les effets à long terme de l'irradiation, l'ergonomie et le stress.

Les bénéfices de l'accroissement de productivité procuré par le changement technologique devraient être partagés, grâce à la réduction du temps de travail. Plus de 66 pour cent des personnes interrogées lors de notre sondage estimaient que les travailleurs devraient participer aux avantages des gains de productivité rendus possibles par le changement technologique.

Par moitiés, elles étaient en faveur d'une moindre durée du travail sans diminution de paie, ou d'une augmentation de la paie pour la même durée de travail, selon leur métier ou leur région de travail.

La mise en place d'un cadre législatif incorporant des normes minimales et une participation garantie améliorerait le processus de consultation entre employeurs et travailleurs, et rendrait possible le partage des coûts et des avantages du changement technologique.

4. La mise en oeuvre d'une stratégie nationale des sciences et de la technologie

On ne peut élaborer de politique des sciences et de la technologie isolément. Il faut l'intégrer dans le cadre de la politique économique et viser à accroître les emplois, assurer la formation des travailleurs et répartir la prospérité.

Nous sommes heureux que le Ministre d'État chargé des Sciences et de la Technologie ait réuni les partenaires sociaux pour en débattre. Nous espérons que cet effort continuera, mais nous soulignons que, pour que cette consultation soit fructueuse, il faudra écouter ce que les parties intéressées ont à dire, et non seulement les entendre.

Le Congrès du travail du Canada préconise une planification économique visant à créer des emplois, à favoriser les investissements socialement utiles et une répartition équitable des revenus et de la prospérité, des services publics suffisants et l'égalité. C'est dans cette perspective que nous participons au débat, et que nous évaluerons les décisions des autorités publiques.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Improving our Industrial Competitiveness

The Canadian Manufacturers' Association

June 8-10, 1986
Winnipeg, Manitoba

EXECUTIVE SUMMARY

To support long-term economic growth so that we can maintain our national prosperity, CMA believes that Canada needs a national science policy that focuses on assisting companies to use technology to improve our industrial competitiveness. This is critical as we move towards a freer trade environment. To encourage and assist federal and provincial governments to develop such a national science policy, this paper reviews what manufacturers have learned about industrial technology development and summarizes and updates previous CMA science policy recommendations.

Government policies have been fairly successful in supporting industrial technology development, as evidenced by the recent sustained growth of industrial R&D, averaging 18 per cent annually over the last seven years. In developing these policies, CMA believes that Canadian policy-makers have come to agree with a number of principles we have advocated. These include the need for a stable healthy economic climate and, in addition, for specific incentives with a long-term commitment. Canadian government support for industrial technology development should also be comparable to the level of support provided in competing countries. While support should be provided through a mix of mechanisms, these should always leave the initiative to companies, not to government, to decide what technology to pursue and what products to develop. Support mechanisms should also generally provide for technology development work to be done in industry.

These principles are incorporated into most government technology support programs, yet there is room for improvement.

TAX INCENTIVES

It is now well accepted that tax incentives are generally the most effective means to support most companies investing in technology. One of the two top priorities for a national science policy should be to improve R&D tax incentives so Canada has the required level and type that industry needs. Specifically this will require provincial governments to stop taxing federal R&D tax incentives and the federal government to extend 100 per cent refundability for unused R&D tax incentives to all companies. Any cap that limits the amount of refundable R&D tax credits should vary as a percentage of company R&D expenditures. The appropriate percentage should be established in consultation with industry. Most recent estimates are that R&D tax incentives cost government (and saved industry) $203 million for 1982. At today's level of industrial R&D spending, we estimate implementing our recommendations would increase government expenditures on R&D tax incentives by $191 million, $48 million of which would be borne by provincial governments and $143 million by the federal government.

GRANTS

No additional government revenues need to be spent on industrial R&D grants which currently cost federal and provincial governments $332 million. But there may be a need to reallocate funds among grant programs, phasing-out those that don't

win the endorsement of their clientele. To make this determination, we recommend each government should review their respective grant programs through a central government agency with participation from industry advisors. Reviews should be based on the following groundrules. Company and not government initiatives should determine what industrial R&D projects a grant funds. Grants generally need simpler administration and increased flexibility so the grant fits the need of the businessman seeking the support rather than the businessman having to fit the requirements of the grant. Internal conflicts in granting agencies that serve more than one purpose should be identified and eliminated so grants are judged only as to whether they make good business sense.

FUNDING UNIVERSITY ACTIVITIES RELATED TO BUSINESS NEEDS

The existing trend of improved collaboration between university researchers and businessmen should be continued. Initiatives to further improve collaboration should be left to those in the business and university communities with governments' role being to financially support such initiatives. To this end federal and provincial government funding agreements are required in three areas. **Providing the required funds should be the other of the top two priorities for a national science policy.** First, there should be reallocations of existing federal and provincial funding for universities to fully fund infrastructure and overhead costs that universities incur in doing business-related research sponsored by NSERC and companies so that such research does not cost a university money. Second, NSERC's second five-year plan, which by 1990 would increase its budget by $391 million, should be approved to strengthen the capabilities of universities to provide the scientific and engineering graduates industry needs. Third, there should be reallocations of existing federal and provincial government funding for universities to provide for the lifetime technical retraining graduates will require. Governments should begin discussions with industry and university representatives to determine what lifetime retraining programs and funding will be needed.

DIFFUSION OF TECHNOLOGY

The appropriate role for governments to play in improving technology diffusion in Canada needs to be determined in developing a national science policy. That role should include attracting foreign investment for the technology this can bring and endorsing the Patent Office becoming a more useful vehicle for disseminating technical information.

TECHNOLOGY CENTRES

The effectiveness of technology centres, the emphasis placed on this policy, how these centres are implemented and operated and how they can be better integrated with higher educational facilities should all be seriously reviewed in developing a national science policy. Specific attention should be given as to whether we need fewer new centres developed in response to company initiatives to replace the many existing centres that seem to have proliferated more in response to political than to market initiatives. Most importantly, any proposals for new centres should be initiated by their intended private sector clients. This would ensure that centres that are established are centres that industry needs and says it needs, not that government thinks industry needs. These recommendations should result in more effective technology centres that will cost governments less money.

GOVERNMENT R&D

In developing a national science policy for Canada, federal and provincial governments should establish the principle that government should not generally do industrial technology work for the purpose of transferring it to industry. The role of government laboratories should generally be confined to doing R&D to meet government departmental needs. Even then the government should, to the greatest extent possible, and more so than at present, contract-out its research requirements, particularly to the private sector. The R&D government needs to do should be better managed through peer review and use of external boards of directors for government laboratories. These measures should result in reduced funding requirements for government R&D laboratories which currently cost $1,529 million.

FUNDING

Improving the effectiveness of industrial R&D tax incentives and providing increased funding for university activities related to business needs must be established as the two top priorities of a national science policy. Required funds should come from reallocating existing government expenditures. First, reduce government funding of government performed R&D to levels closer to those in other OECD countries. This could save $581 million, approximately enough to implement our recommendations to improve R&D tax incentives ($191 million) and to approve NSERC's second five-year plan ($391 million). Such a reallocation of funds is justified as a better way to spend scarce resources and because the recommendations above for government R&D should result in reduced funding requirements for government laboratories. Second, additional funding from outside federal and provincial government science envelopes will also be required. Such additional funding for our recommendations concerning university activities should come from reallocations within federal and provincial government education spending envelopes. Although reallocations of expenditures by governments on government performed R&D and reallocations within educational funding should be sufficient to implement our recommendations, this may not be practical. To the extent this is so there should also be a general reallocation of government expenditures to implement our recommendations to improve tax incentives and to increase university funding. Such funding reallocations would be justified. Canada needs to, but does not, match the level of support provided to industrial R&D by our competitors. More importantly, increased expenditures to support industry's needs for R&D funding and for more competent technology graduates are demonstrably justified on economic grounds.

PRÉCIS ADMINISTRATIF

Pour assurer la croissance économique à long terme qui lui permettra de maintenir sa prospérité, le Canada a besoin, de l'avis de l'Association des manufacturiers canadiens (AMC), d'une politique scientifique nationale visant à aider les entreprises à se servir de la technologie pour accroître leur compétitivité industrielle. Une telle initiative est extrêmement importante dans le contexte du libre-échange qui se pointe à l'horizon. Afin d'encourager et d'aider les gouvernements fédéral et provinciaux à élaborer cette politique scientifique nationale, le présent document examine ce que les manufacturiers ont appris au sujet du développement technologique, et il résume et met à jour des recommandations antérieures de l'AMC en ce qui concerne la politique scientifique.

Les politiques gouvernementales ont passablement bien réussi à appuyer le développement technologique industriel, comme en fait foi la croissance soutenue de la R-D industrielle, qui a enregistré un taux moyen de 18 pour cent par année au cours des sept dernières années. L'AMC estime que les responsables de ces politiques canadiennes ont reconnu un certain nombre de principes qu'elle a préconisés, entre autres : la nécessité d'avoir un climat économique stable et sain, et des encouragements fiscaux accompagnés d'un engagement à long terme. L'appui du gouvernement canadien au développement technologique industriel devrait également se comparer à celui fourni par des pays concurrentiels. Cet appui devrait s'exprimer par différents mécanismes, mais ceux-ci devraient toujours laisser aux compagnies, et non au gouvernement, le soin de déterminer les technologies à exploiter et les produits à développer. En outre, ces mécanismes devraient généralement prévoir que le travail de développement technologique se fera au sein des entreprises.

Ces principes se retrouvent dans la plupart des programmes d'appui du gouvernement au développement technologique; des améliorations peuvent toutefois être apportées.

ENCOURAGEMENTS FISCAUX

Il est maintenant reconnu que les encouragements fiscaux constituent généralement les moyens les plus efficaces d'appuyer la plupart des entreprises qui investissent dans le développement technologique. L'une des deux priorités d'une politique scientifique nationale devrait consister à améliorer les encouragements fiscaux à la R-D pour que leur nombre et leur nature correspondent à ce dont les entreprises ont besoin. Plus précisément, les

gouvernements provinciaux devront cesser d'imposer les encouragements fiscaux à la R-D et le gouvernement fédéral devra étendre à toutes les entreprises le remboursement de 100 pour cent des encouragements fiscaux à la R-D non utilisés. Toute limite du montant des crédits d'impôt à la R-D remboursables devrait représenter un pourcentage des dépenses de l'entreprise au titre de la R-D. Ce pourcentage devrait être fixé en consultation avec l'industrie. Selon les plus récentes estimations, les encouragements fiscaux à la R-D ont coûté au gouvernement (et fait épargner à l'industrie) 203 millions de dollars pour 1982. Au niveau actuel des dépenses des entreprises au titre de la R-D, nous estimons que la mise en oeuvre de nos recommandations aurait pour effet d'accroître les dépenses gouvernementales au titre des encouragements fiscaux à la R-D de 191 millions de dollars : un montant de 48 millions de dollars serait assumé par les gouvernements provinciaux et un montant de 143 millions de dollars par le gouvernement fédéral.

SUBVENTIONS

Il n'y a pas lieu d'affecter une plus grande part des recettes publiques aux subventions au titre de la R-D, qui coûtent actuellement 332 millions de dollars aux gouvernements fédéral et provinciaux. Mais il faudra peut-être redistribuer les fonds entre les programmes de subventions, en éliminant graduellement ceux qui ne reçoivent pas l'appui de leur clientèle. À cette fin, nous recommandons que chaque gouvernement examine ses propres programmes de subventions par l'entremise d'un organisme central, avec la participation de conseillers de l'industrie. Cet examen devrait se fonder sur les règles suivantes. Il incombe aux entreprises, et non aux gouvernements, de déterminer les projets de R-D qui sont financés par une subvention. De façon générale, les programmes de subventions requièrent une administration plus simple et une souplesse plus grande, de sorte que les subventions répondent aux besoins des entreprises qui recherchent une aide au lieu de forcer les entreprises à s'adapter aux conditions des subventions. Les conflits internes au sein des organismes subventionnaires qui servent plus d'une fin devraient être identifiés et éliminés, pour que les subventions soient jugées uniquement en fonction de leur utilité.

LE FINANCEMENT DES ACTIVITÉS UNIVERSITAIRES LIÉES À DES BESOINS DES ENTREPRISES

La tendance actuelle à la collaboration entre les chercheurs des universités et les entreprises devrait se poursuivre. Les initiatives visant à accroître cette collaboration devraient être laissées aux membres des entreprises et des universités, et le rôle des gouvernements devrait consister à accorder une aide financière

pour ces initiatives. À cette fin, des ententes de financement entre les gouvernements fédéral et provinciaux sont nécessaires dans trois domaines. **L'autre grande priorité pour une politique scientifique nationale devrait être de fournir les fonds nécessaires.** Premièrement, les fonds qui sont actuellement accordés aux universités par les gouvernements fédéral et provinciaux devraient être redistribués, de manière à financer pleinement les frais d'infrastructure et généraux que les universités subissent en effectuant des recherches qui sont liées à des besoins des entreprises et qui sont financées par le CRSNG et des entreprises; ainsi, ces recherches ne coûteraient rien aux universités. Deuxièmement, le deuxième plan quinquennal du CRSNG, qui devrait augmenter son budget de 391 millions de dollars d'ici 1990, devrait être approuvé afin de mieux permettre aux universités de produire les diplômés en sciences et en génie dont les entreprises ont besoin. Troisièmement, les fonds qui sont actuellement accordés aux universités par les gouvernements fédéral et provinciaux devraient être redistribués, de manière à assurer le recyclage technique permanent dont les diplômés auront besoin. Les gouvernements devraient entamer des discussions avec des représentants des entreprises et des universités dans le but de déterminer les programmes et les fonds de recyclage permanent qui seront nécessaires.

DIFFUSION DE LA TECHNOLOGIE

Le rôle que doivent jouer les gouvernements en vue d'améliorer la diffusion de la technologie au Canada doit être déterminé lors de l'élaboration d'une politique scientifique nationale. Ce rôle devrait consister notamment à attirer les investissements étrangers et les technologies qu'ils peuvent apporter, et à encourager le Bureau des brevets à devenir un meilleur instrument de diffusion de l'information technique.

CENTRES DE TECHNOLOGIE

Efficacité des centres de technologie, importance accordée à cette politique, façon dont ces centres sont mis en oeuvre et exploités, et moyens de mieux les intégrer aux installations des universités : tous ces points devraient être examinés à fond lors de l'élaboration d'une politique scientifique nationale. On devrait particulièrement décider si nous avons besoin d'un plus petit nombre de nouveaux centres établis en réponse à des initiatives d'entreprises en vue de remplacer les nombreux centres existants qui semblent avoir proliféré à la suite d'initiatives plus politiques que commerciales. Et, ce qui est encore plus important, toutes les propositions relatives à de nouveaux centres devraient provenir de leurs clients prévus du secteur privé. De cette

façon, les nouveaux centres répondront aux besoins de l'industrie tels qu'ils sont perçus par celle-ci et non tels qu'ils sont perçus par le gouvernement. Ces recommandations devraient donner des centres de technologie plus efficaces qui coûteront moins cher aux gouvernements.

R-D GOUVERNEMENTALE

Lors de l'élaboration d'une politique scientifique nationale pour le Canada, les gouvernements fédéral et provinciaux devraient poser le principe suivant : règle générale, le gouvernement ne devrait pas effectuer des travaux technologiques dans le but de les transférer à l'industrie. Le rôle des laboratoires gouvernementaux devrait normalement se limiter aux travaux de R-D qu'exigent les besoins des ministères. Et, même là, le gouvernement devrait, dans la mesure du possible et plus qu'il ne le fait présentement, confier ses travaux à des chercheurs indépendants, en particulier dans le secteur privé. La R-D dont le gouvernement a besoin devrait être mieux gérée au moyen d'un mécanisme d'examen par les pairs et de conseils d'administration de l'extérieur pour les laboratoires gouvernementaux. Ces mesures devraient permettre de réduire les besoins de financement des laboratoires gouvernementaux, qui coûtent actuellement 1 529 millions de dollars.

FINANCEMENT

Les deux priorités d'une politique scientifique nationale devraient être les suivantes : améliorer l'efficacité des encouragements fiscaux à la R-D industrielle et augmenter les fonds consacrés aux activités universitaires liées à des besoins des entreprises. Les fonds requis devraient provenir d'une redistribution des dépenses actuelles des gouvernements. Premièrement, il faut ramener le financement du gouvernement pour la R-D gouvernementale à des niveaux qui se rapprochent davantage de ceux d'autres pays de l'OCDE. Le gouvernement pourrait ainsi économiser 581 millions de dollars, ce qui est à peu près suffisant pour mettre en oeuvre nos recommandations visant à améliorer les encouragements fiscaux à la R-D (191 millions de dollars) et à approuver le deuxième plan quinquennal du CRSNG (391 millions de dollars). Une telle redistribution des fonds est justifiée, parce qu'elle représente une meilleure façon d'utiliser des ressources rares et parce que les recommandations susmentionnées pour la R-D gouvernementale devraient permettre de réduire les besoins de financement des laboratoires gouvernementaux. Deuxièmement, il faudra également des fonds supplémentaires provenant de l'extérieur des enveloppes scientifiques des gouvernements fédéral et provinciaux. Ces fonds pour mettre en oeuvre nos recommandations concernant les activités universitaires devraient

provenir de réaffectations à l'intérieur des enveloppes des dépenses éducatives des gouvernements fédéral et provinciaux. Les redistributions des dépenses des gouvernements concernant la R-D gouvernementale ainsi que les réaffectations au sein des enveloppes éducatives devraient suffire à mettre en oeuvre nos recommandations; cependant, cette situation pourrait ne pas être pratique. Le cas échéant, il devrait donc également y avoir une redistribution générale des dépenses gouvernementales pour mettre en oeuvre nos recommandations visant à améliorer les encouragements fiscaux et à accroître les fonds accordés aux universités. Une telle redistribution des fonds serait justifiée. Le Canada devrait appuyer la R-D industrielle de la même façon que le font nos concurrents, mais il ne le fait pas. Et, ce qui est encore plus important, l'augmentation des dépenses pour répondre aux besoins de l'industrie en R-D et en diplômés plus compétents se justifie facilement sur le plan économique.

The Canadian
Manufacturers'
Association

Improving our Industrial Competitiveness

A Science Policy for Canada

February 1986
A Discussion Paper by
The Canadian Manufacturers' Association

The Canadian
Manufacturers'
Association

Helping Manufacturers Grow

February 1986

The Hon. Frank Oberle, P.C., M.P.
Minister of State for Science and Technology
House of Commons
Ottawa, Canada
K1A 0A6

Dear Minister:

The CMA applauds and encourages the initiative of federal and provincial science ministers in developing a national science policy for Canada. We believe this policy needs a focus and that focus must be how we can use science policy to improve the competitiveness of Canadian industry. This is critical as we move towards a freer trade environment.

In the attached paper CMA outlines specific recommendations for a national science policy. Our recommendations build on a number of principles we have previously advocated and which we believe government policy-makers have come to accept. Implementing our recommendations will require federal and provincial governments to make very substantial reallocations in their existing budgets for technology support and education. However, if these reallocations are made, our recommendations should not require new government expenditures that would increase the deficit. To summarize:

1. Industrial R&D tax incentives are generally the best way to support industrial R&D. The present incentives require improvement and this should be a top priority. Provincial governments should stop taxing federal R&D tax incentives and the federal government should extend 100 per cent refundability for unused R&D tax credits to all companies. We estimate these measures will cost $191 million ($143 million federal and $48 million provincial costs).

2. There should be no additional funding for industrial R&D grants which currently cost federal and provincial governments $332 million. Each government should review its grant programs to reallocate funds and phase out grants that do not win the endorsement of their intended clientele. Reviews should be carried out by central government agencies with participation from industry advisors. Specific groundrules are recommended for such reviews.

3. University and business collaboration should be further strengthened. Initiatives should be left to universities and companies, with governments then providing funding. Federal and provincial government funding agreements are required to fully fund the infrastructure and overhead costs universities incur in doing business-related research and to strengthen the capability of universities to provide the graduates Canadian industry needs and the lifetime technical

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retraining such graduates will require. These recommendations should be top priorities. They will require reallocations of existing federal and provincial funding for universities and federal approval of NSERC's second five-year plan. That plan recommends the Council's budget increase from $312 million in 1984-85 to $703 million in 1990, (in 1984-85 dollars) an increase of $391 million.

4. Attracting foreign investment for the technology it can bring and using the Patent Office to disseminate technical information should improve technology diffusion.

5. Federal and provincial government policy for technology centres needs to be reviewed. Centres that are maintained should be those that industry supports and clearly needs and those centres should be more integrated with educational facilities. These recommendations can both save money and make technology centres more effective.

6. Government R&D should generally be confined to meeting government departmental needs and should be better managed through peer review and use of external boards. Contracting-out policies should be pursued more vigorously. These recommendations can save money and reduce the $1,529 million governments currently spend on government R&D.

7. Funding required to implement our recommendations should come from reducing government funding of government R&D to levels closer to those in other OECD countries (this should free-up approximately $581 million), by reallocations within the federal and provincial government education envelopes and, to the extent necessary, by a general reallocation of government expenditures.

This submission is being sent to all federal and provincial ministers responsible for science policy. CMA's recommendations are based on what manufacturers have learned over the past decade about technology, competitiveness and how the two are intertwined. The government funding that our recommendations require is demonstrably justified on economic grounds. We believe these recommendations should be the basis for the science policy that Canada develops — one which improves our competitive position and thereby helps maintain our standard of living.

Yours sincerely,

J. Laurent Thibault
President

Improving our Industrial Competitiveness

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EXECUTIVE SUMMARY

To support long-term economic growth so that we can maintain our national prosperity, CMA believes that Canada needs a national science policy that focuses on assisting companies to use technology to improve our industrial competitiveness. This is critical as we move towards a freer trade environment. To encourage and assist federal and provincial governments to develop such a national science policy, this paper reviews what manufacturers have learned about industrial technology development and summarizes and updates previous CMA science policy recommendations.

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The appropriate role for governments to play in improving technology diffusion in Canada needs to be determined in developing a national science policy. That role should include attracting foreign investment for the technology this can bring and endorsing the Patent Office becoming a more useful vehicle for disseminating technical information.

TECHNOLOGY CENTRES

The effectiveness of technology centres, the emphasis placed on this policy, how these centres are implemented and operated and how they can be better integrated with higher educational facilities should all be seriously reviewed in developing a national science policy. Specific attention should be given as to whether we need fewer new centres developed in response to company initiatives to replace the many existing centres that seem to have proliferated more in response to political than to market initiatives. Most importantly, any proposals for new centres should be initiated by their intended private sector clients. This would ensure that centres that are established are centres that industry needs and says it needs, not that government thinks industry needs. These recommendations should result in more effective technology centres that will cost governments less money.

GOVERNMENT R&D

In developing a national science policy for Canada, federal and provincial governments should establish the principle that government should not generally do industrial technology work for the purpose of transferring it to industry. The role of government laboratories should generally be confined to doing R&D to meet government departmental needs. Even then the government should, to the greatest extent possible, and more so than at present, contract-out its research requirements, particularly to the private sector. The R&D government needs to do should be better managed through peer review and use of external boards of directors for government laboratories. These measures should result in reduced funding requirements for government R&D laboratories which currently cost $1,529 million.

FUNDING

Improving the effectiveness of industrial R&D tax incentives and providing increased funding for university activities related to business needs must be established as the two top priorities of a national science policy. Required funds should come from reallocating existing government expenditures. First, reduce government funding of government performed R&D to levels closer to those in other OECD countries. This could save $581 million, approximately enough to implement our recommendations to improve R&D tax incentives ($191 million) and to approve NSERC's second five-year plan ($391 million). Such a reallocation of funds is justified as a better way to spend scarce resources and because the recommendations above for government R&D should result in reduced funding requirements for government laboratories. Second, additional funding from outside federal and provincial government science envelopes will also be required. Such additional funding for our recommendations concerning university activities should come from reallocations within federal and provincial government education spending envelopes. Although reallocations of expenditures by governments on government performed R&D and reallocations within educational funding should be sufficient to implement our recommendations, this may not be practical. To the extent this is so there should also be a general reallocation of government expenditures to implement our recommendations to improve tax incentives and to increase university funding. Such funding reallocations would be justified. Canada needs to, but does not, match the level of support provided to industrial R&D by our competitors. More importantly, increased expenditures to support industry's needs for R&D funding and for more competent technology graduates are demonstrably justified on economic grounds.

IMPROVING OUR INDUSTRIAL COMPETITIVENESS
A SCIENCE POLICY FOR CANADA

THE OBJECTIVE

The importance of science and technology to Canada's long-term economic growth is now widely accepted as evidenced in a number of recent reports.

- The rate of growth of our income per capita - a measure of our wealth as a nation - ultimately depends on the rate of productivity growth of labour and capital. The rate of productivity growth depends, to a considerable extent, on the rate of technological advance or progress. (Report of the Royal Commission on the Economic Union and Development Prospects for Canada, September 1985 - the Macdonald Royal Commission.)

- "As much as two-thirds of recent growth has been attributed to technological change and there is every reason to believe that its influence will grow. If we are to be competitive, we must become effective in applying leading edge technologies in producing goods and services." (A New Direction for Canada: An Agenda for Economic Renewal, Department of Finance, 1984.)

- "Technology development is of overriding importance to Canada's continued prosperity - indeed, to our survival as an industrial power." (Task Force on Federal Policies and Programs for Technology Development, July 1984 - the Wright Report.)

- "The imperative of using technology as a competitive weapon must apply throughout a broad range of Canadian industry. The private sector must sustain its recent significant growth in industrial research and development spending. Here, continued government support for industrial R&D is essential." (A Future That Works, September 1984, The Canadian Manufacturers' Association.)

- "Ministers highlighted the important role that science, technology and innovation must play in economic renewal and recommend that the First Ministers endorse science and technology as a priority area for investment and funding, identifying it as a source of economic growth and job creation." (Joint Communique of Federal/Provincial/Territorial Conference of Ministers of Science and Technology, February 1985.)

Now that the importance of science and technology to Canada's continued prosperity is clearly recognized, federal and provincial ministers responsible for science have committed themselves to developing a comprehensive national science policy

As viewed by the CMA, science policy is a broad and comprehensive subject. It encompasses the whole range of science and technology activities that are essential to assist Canadian companies to access, develop and use the technology they need to improve both the individual company's business position and, in the broader context, Canada's industrial competitiveness. **To support long-term economic growth so that we can maintain our national prosperity, Canada needs a science policy that is focused on assisting companies to develop and use technology to improve Canada's industrial competitiveness.**

In a series of submissions over the last ten years, The Canadian Manufacturers' Association has recommended what government policies are required to support and encourage industrial technology investment. To assist federal and provincial governments in developing a national science policy, this paper summarizes what manufacturers have learned about industrial technology development and also summarizes and updates previous CMA recommendations as to what science policies Canada needs.

THE COMPANY COMMITMENT

Canadian companies clearly recognize they must commit more investment to technology if they are to survive increasing international competition. This commitment is reflected in the recent sustained growth of industrial R&D, averaging 18 per cent annually over the last seven years. As Table 1 shows, this commitment is widespread throughout Canadian industry as all sectors have significantly increased their R&D expenditures. The reason for this commitment is simple. Improving our own use of technology is the only way we will keep ahead of our competitors, particularly as we move towards a freer trade environment.

Competitors from industrial countries are improving their own use of technology and competitors from newly industrialized countries are increasingly using technology in combination with their lower cost base. In short, Canadian companies are in a global technology race.

THE NEED FOR SUPPORT

Although necessary to a company's continued survival and to Canada's continued prosperity, technology investment is expensive and risky with a longer pay-back period than many shorter-term investment alternatives. **As a result, Canada, like most countries, has recognized the need for specific policies to support industrial technology development.** In developing policies that have been fairly successful in this area, we believe that Canadian policy-makers have come to agree with the following principles which industry has advocated.

TABLE I

R&D Expenditures in the Business Enterprise Sector, by Selected Industries								
Industry	1977	1978	1979	1980	1981	1982	1983p	1984p
				millions of dollars				
Mines and primary metals ..	74	84	100	137	158	151	135	160
Gas and oil wells, petroleum products	107	135	203	230	327	325	342	321
Food, beverages and tobacco	29	32	35	45	56	68	80	78
Wood based industries	36	36	53	65	84	77	76	77
Business machines	14	18	27	45	56	86	107	104
Other machinery	42	43	55	68	85	86	71	78
Aircraft and parts	95	131	153	174	255	294	284	269
Other transportation equipment	21	22	33	38	60	59	62	59
Communications equipment	151	174	217	264	383	516	631	749
Other electrical products	32	38	53	67	79	86	100	106
Drugs and medicines	29	32	42	55	53	56	65	53
Other chemical products	48	54	66	87	102	132	135	125
Other manufacturing industries	41	48	59	76	93	110	106	109
Electrical power utilities	43	56	69	76	92	118	140	157
Other non-manufacturing industries	94	103	99	137	194	216	213	231
Total	**855**	**1,005**	**1,263**	**1,565**	**2,078**	**2,380**	**2,548**	**2,673**

SOURCE: Statistics Canada, Science and Technology Indicators 1984, Table 3.5

PRINCIPLES FOR SUPPORT

- **A stable healthy economic climate** is the single most important factor influencing corporate investment in technology. Just as innovation stimulates good economic performance, good economic performance stimulates innovation.

- While a sound economic environment is essential, it is not sufficient. Governments also need to provide **specific incentives for industrial investment in technology,** its development and its applications.

- To be meaningful, **technology support must be stable** with a long-term commitment. This is critical because technology investment involves long-term projects with a long-term commitment of resources before a pay-back can be expected.

- The overall level of support from federal and provincial governments to Canadian industry for technology development should **be comparable to the level of support provided in competing countries.**

- Support should be provided through a **mix of mechanisms** to address different business situations.

- Whatever the government support mechanism, it should **leave the initiative to industrial firms** operating in the marketplace to decide what technology to pursue. Industry is much more closely linked to the marketplace than government so industry, not government, should pick the technology winners and the products that should be developed. This is essential if we are to be successful in export markets and in replacing imports.

- **Generally industrial technology development should be done in industry laboratories** not in laboratories outside of industry with a view to transferring R&D to industry. Success in applying technology in business is directly related to the links researchers have to the marketplace. Industry laboratories are much closer to the market than government or other outside laboratories.

TYPES OF SUPPORT

Tax incentives, grants, support for university and industry collaboration and technology centres are the primary mechanisms presently used by federal and provincial governments to support industrial technology development in Canada. While the principles for government support outlined above are generally incorporated into these support mechanisms there is room for improvement. **The recommendations set out below should be accepted and implemented by federal and provincial governments as part of a national science policy for Canada.**

TAX INCENTIVES

As reflected in the Wright Report, the Macdonald Royal Commission Report and, indeed, in federal government policy, it is now well accepted that **tax incentives are generally the most effective means to support most companies investing in technology.** Tax incentives support research that is done in industry and the decisions as to what technology development activities to pursue are solely those of the businessman.

The federal government has responded to recommendations by industry that the primary support for industrial R&D should be provided through tax incentives by introducing a series of increasingly more generous incentives. An initial problem with tax incentives was that many firms were not in a taxable position and thus could not take advantage of them. A study by Mansfield and Switzer (The Effects of R&D Tax Credits and Allowances in Canada) concluded that in 1980 almost

one-third of the R&D in Canada was done by firms that did not have sufficient taxable income to use any of their R&D tax credits and, in addition, another third was carried out by firms that could not use all of their R&D credits during the year

To address the problem of R&D tax incentives that could not be used the scientific research tax credit (SRTC) was introduced in 1983. It enabled companies that were not in a position to utilize their R&D tax credits to, in effect, sell them to others. When the SRTC was in place CMA assessed its impact. As stated in CMA's White Paper "A Future that Works", CMA concluded that, at long last, Canada had the required level of tax support mechanism that we needed. However, problems developed with the SRTC as there were inadequate controls to ensure that the research the incentive was claimed for was actually done. As a result a moratorium was placed on the SRTC in the fall of 1984 and the spring 1985 federal Budget announced its termination. In its place a 100 per cent refundable tax credit provision was introduced for unused R&D tax credits for small companies. The provision had a cap so it actually applied to unused R&D tax credits on the first $2 million of R&D performed by small Canadian-controlled private corporations such that, at their tax rates, the maximum refundable credit amounted to $700,000. While this appears to be an acceptable alternative to the SRTC for such small companies, it leaves other companies with the same problem they had before the introduction of the SRTC, namely that many may not be in a position to use their R&D tax incentives.

To make R&D tax incentives truly effective they need to be available to all companies, whether or not they are in a taxable position. We note that the Macdonald Royal Commission Report supports this position. If SRTCs are not going to be reintroduced, we recommend that **the provisions for 100 per cent refundability for unused R&D tax credits need to be extended to all companies.** If this is done, the current cap on the refundable credit, as it applies to small companies, should be increased so as to enable companies spending more than $2 million on R&D who are not in a taxable position to utilize a meaningful portion of their unused R&D tax incentives. **We specifically recommend that any cap on refundable R&D tax credits should vary as a percentage of company R&D expenditures and that the appropriate percentage be established through consultation with industry.** Whether introducing a refundable tax credit as recommended above would be a sufficient step by the federal government to replace SRTCs would need to be evaluated after some experience with the incentive.

The 1985 federal Budget proposals also addresses a long-standing problem that overly restrictive interpretations by Revenue Canada of what R&D expenditures are eligible for R&D tax incentives have often resulted in the incentives applying to research but not to development. A new, broader definition, proposed in the 1985 spring Budget, should clarify that incentives are available for both research and development. A final assessment as to improvements that will result from this new definition will need to await company experience with how Revenue Canada interprets the new definition.

A further long-standing problem limiting the effectiveness of federal R&D tax incentives is that provincial governments, in effect, tax federal R&D tax credits to industry. As a result, part of the R&D tax credit is syphoned into provincial revenues and supports the province rather than industrial R&D. This provincial practice should end.

Industry regards R&D tax incentives as the most effective form of government support for industrial technology development. **One of two top priorities of a national science policy aimed at assisting companies to develop and use technology to improve their competitiveness should be to improve R&D tax incentives. To have the required level and type of R&D tax incentives that industry needs, provincial governments should stop taxing federal R&D tax incentives and the federal government should extend 100 per cent refundability for unused R&D tax incentives to all companies.**

Cost: The most recent estimate is that industrial R&D tax incentives in 1982 cost government and saved industry $203 million. At today's level of industrial R&D spending, implementing our recommendation to provide full refundability and to stop provincial taxation of federal R&D tax incentives would, we estimate, increase government expenditures on R&D tax incentives by $191 million; $48 million of which would be borne by provincial governments and $143 million by the federal government (See Appendix I).

GRANTS

Tax incentives cannot address all business situations, particularly cash flow problems of small businesses in the start-up phase and, for all companies, those situations where more support is required than could be provided by tax incentives. For these reasons, grants to support industrial technology development and its application are necessary.

CMA believes the level of federal and provincial industrial R&D grant programs in Canada ($332 million) is adequate at present and no additional government revenues need be spent on grants as part of developing a national science policy aimed at improving industrial competitiveness. However, there may be a need to reallocate funds among some grant programs. In fact, we concur with recommendations made in the Wright Report that R&D grant programs should be reviewed with a view to gradually phasing-out those that have failed to win the endorsement of their intended clientele. Any such review should include the following groundrules.

- **Grant programs must be clearly defined so company initiatives and not government initiatives determine what industrial R&D projects are funded.** For grants to work the company rather than the government needs to pick the winning technology that the grants will support.

- Grant programs need to be examined for opportunities to **simplify administration and increase flexibility.** There are some good examples to follow. The Natural Sciences and Engineering Research Council (NSERC), in awarding grants to increase cooperation between university researchers and industry, "will consider any good proposal involving joint university/industry efforts." The administration of other grant programs should aim to achieve similar flexibility. **The grant needs to fit the requirements of the businessman seeking the support rather than the businessman having to fit the requirements of the grant.**

- Internal conflicts in granting agencies should be identified as **grant programs could direct more support to projects that made the best business sense if internal conflicts within granting agencies were eliminated.** Conflicts may arise, for example, in the National Research Council (NRC) as it both administers grants and does R&D in its own laboratories. The result can be that grants to support industrial R&D in the areas that are closest to NRC research activities are given more favourable treatment than grants for research activities NRC is not interested in but are important to industry. Another example of potential conflict is that DRIE promotes regional development as well as supporting technology. The result can be support for projects that are in keeping with DRIE regional development objectives rather than support for projects that make the most business sense.

In developing a national science policy for Canada we recommend that there be a review of grant programs as suggested above. For each province and for the federal government such a review should be conducted by a centralized government agency with participation from industry advisors. In all cases the results of the review and recommendations for changes should be made public.

FUNDING UNIVERSITY ACTIVITIES RELATED TO BUSINESS NEEDS

The existing trend of improved collaboration between university researchers and businessmen should be continued and this should be identified as a priority objective in a national science policy for Canada. In such collaboration manufacturers are primarily interested in ensuring that the education and training university graduates receive will equip them to meet industry's technology manpower needs. University/industry cooperation on technology projects may also have a secondary benefit of assisting companies to develop technology for their market needs. But the longer-term, more important benefit, is that graduates working on industry sponsored projects are exposed to the discipline of working on industrially relevant technology.

A few years ago, the Science and Technology Committee of the CMA discussed with the Association of Universities and Colleges of Canada and with certain universities, how universities could increase their support of industrial research and how improved collaboration between university researchers and businessmen could be achieved. Five conclusions emerged which should be taken into account in understanding the very limited role governments can play in improving university and industry collaboration. In the end this is up to individual companies and individual universities. The five conclusions were:

(1) Improved cooperation can be achieved to the benefit of both universities and industries. While there are attitudinal and institutional barriers to cooperation, these are often more perceived than real. They can usually be worked out when a university and a company decide to work together.

(2) Establishing umbrella networking mechanisms is generally not the answer to improving cooperation. Circumstances where this can work would seem to be in mature industries with little product differentiation (e.g. the steel industry and the Canadian Steel Industrial Research Association) or for fundamental work in frontier research areas (e.g. the artificial intelligence project of the Canadian Institute for Advanced Research). In these cases establishing networking organizations to tap diffused university expertise has proved to be worthwhile. However, decisions to cooperate more closely normally will be on an individual company to university basis, and most often will result from personal contacts. Setting up broad networking mechanisms aimed at either communicating industrial R&D needs to universities or communicating university R&D expertise to businessmen has been thoroughly investigated a number of times and the conclusion has been than this approach should generally not be pursued.

(3) Company initiatives normally spark cooperation. Company initiatives will occur when a firm identifies a particular problem and decides to investigate whether one or more universities can assist it in finding the solution. The university that is most likely to be contacted is one that is linked to the company through a network of personal contacts. A well-publicized university research office may also attract contacts.

(4) Cooperation will more likely be successful if the university that is contacted has an administrative structure to encourage and deal with industrial contacts. This office could refer industries' contacts to appropriate university scientists and deal with institutional barriers to cooperation on the company's behalf.

(5) Universities should develop a web of relationships with local industrial clientele to encourage company contacts. Technical workshops sponsored by universities and focused on problems at the scientist-to-scientist level can be useful in developing such relationships. So too can the practice of encouraging the development of research parks on or near campus facilities.

The theme of these conclusions and of CMA's recent report to the The Commission on the Future Development of the Universities of Ontario (the Bovey Commission) is that **initiatives to improve links between university researchers and business should be left to those in the business and university communities.** There is no need for government direction or initiative in determining what university/industry interactions should be and how they should be improved. **However, there is an important role for government to play in supporting increased university industry collaboration by providing financial support to business and university interactions that are initiated by those in the business and university communities.**

In this respect university activities related to business needs should receive additional funding to: (1) provide full funding for the infrastructure and overhead costs that universities incur in doing business-related research; (2) strengthen the capabilities of universities to provide the science and engineering graduates that Canadian companies will need; and (3) strengthen the capabilities of universities to provide lifetime technical retraining that industry employees will increasingly require. **The other of the two top priorities for a national science policy should be for federal and provincial governments to agree on how to provide the additional funding that will be required to meet these three needs.**

FULL FUNDING

Government funding to improve university and industry research collaboration is specifically required for the overhead and infrastructure costs associated with this research so that it can be fully funded. Sufficient funding from a company or from the Natural Sciences and Engineering Research Council (NSERC) may be available for actual research on a cooperative university and industry research project. But this research funding must be matched by funds for the related expenses such as infrastructure and overhead costs that a university incurs in doing the research. These are significant costs. For example, NSERC estimates that for each dollar of funding it provides to a university, the university will incur a $1.30 in additional expenses (20 cents for direct research costs NSERC does not fund, 55 cents for indirect costs excluding faculty time and 55 cents for indirect costs of faculty time). Without matching funds to cover these costs, universities are constrained from doing the research projects companies and NSERC are willing to fund and this is a major obstacle to encouraging universities to do more research that is relevant to company needs.

In developing a solution to fully fund the infrastructure and overhead costs that universities incur in doing business-related research work, it is important that funding be provided in a way that does not interfere with decisions by companies and universities as to what projects to do. Since the federal government already contributes substantially to improving university collaboration with industry through NSERC, one solution to provide the required full funding would be for provincial governments to provide matching funding for related expenses whenever NSERC or company funding for a university/industry research project is provided. This is a recommendation CMA has previously made in "A Future That Works". If such an agreement cannot be reached with provincial governments, the only practical solution may be for full NSERC funding of the business-related university research that NSERC sponsors. This solution for full funding by the federal government, through NSERC, has been recommended by the Wright Report.

Cost: The Macdonald Royal Commission also recommended full cost funding and points out "this need not involve an increase in total support of university R&D." We agree. Full funding should be achieved through reallocations in existing federal and provincial funding for universities.

MEETING INDUSTRY'S NEEDS FOR UNIVERSITY GRADUATES

The federal government, through NSERC, must continue to strengthen the capabilities of universities to provide the science and engineering graduates that Canadian companies will need. The quality of graduates, their exposure to industrially relevant educational training and the number of such graduates all need to increase. As the largest single source of funding of university R&D in Canada, NSERC has effectively promoted these objectives. NSERC has done this by increasing its grant programs in its first five-year plan and using its grants with the degree of flexibility needed so that decision-making is left to those in the business and university communities.

Further encouragement and funding by the federal government to improve the capabilities of universities to provide the graduates industry needs should be provided through NSERC. Specifically the increase in funding recommended in NSERC's second five-year plan should be approved.

In previous recommendations to the federal government to approve NSERC's second five-year plan, CMA expressed confidence that NSERC would continue to be increasingly successful in encouraging universities to meet manufacturers' needs - for their primary product of university graduates and their secondary product of university research capability. Nevertheless, we believe that NSERC's efforts to make university graduates and university research even more relevant and useful to industry could and should be improved. To achieve this we recommend that the present trend towards increased industry representation on the NSERC Council and its committees be continued. While progress has been made to achieve this objective, there still remains a disproportionate number of government and academic representatives on both the Council and the peer review committees.

In recommending approval of NSERC's second five-year plan, CMA particularly emphasizes the importance of improving the quality of tomorrow's science and engineering graduates as well as increasing their industrially relevant research experience and training. NSERC's plan also emphasizes the need to increase the number of graduates available to industry. We agree with this objective. One approach to this problem may be for graduates to move more quickly from university training into industry jobs. To this end CMA is currently investigating with a number of university representatives whether the time it takes to obtain a Ph.D in the sciences and engineering could be substantially shortened.

Cost: The recommendation to approve NSERC's second five-year plan will mean significant costs. The plan recommends a real growth in the Council's budget of 18 per cent per year from $312 million in 1984-85 to $703 million (1984-85 dollars) in 1990, an increase of $391 million.

LIFETIME TRAINING

Today's rate of technological progress requires constant upgrading of the technical knowledge of the professional engineer and scientists and other personnel working in industry. Businesses and universities, as well as community colleges, will need to develop programs to provide the retraining that is required today and will be increasingly required tomorrow. As such retraining programs are developed, there will likely be a need for government financial support to supplement the funding provided by those receiving the retraining and their companies. Federal and provincial governments should begin working with industry and university representatives to determine what type of government funding will be required, which level of government will provide it and how.

Cost: The cost of implementing this recommendation for lifetime training cannot be known until the needs are more precisely identified. Required funding should be obtained from reallocating existing federal and provincial funding for education and training.

DIFFUSION OF TECHNOLOGY

Studies suggest that the spread of new technology throughout Canada has been slow. The diffusion of technology is perhaps of even greater importance to Canadian manufacturers than the development of new technology. Those companies and

countries that adopt new technology before others derive the most benefit. **The appropriate role for governments to play in improving technology diffusion in Canada needs to be determined in developing a national science policy for Canada.**

In previously addressing this issue in "A Future That Works", CMA made the following observations concerning foreign investment and the Patent Office.

As to foreign investment, we said "government policy needs to recognize that foreign multinational corporations are an asset in getting the industrial technology Canada needs. No company will normally duplicate available R&D that has been done elsewhere. In this respect multinationals are a very effective conduit for the new technology that Canada needs and this role of multinationals should be welcomed."

For a number of reasons, including the technology foreign investment can bring, the advantages of attracting foreign investment now seem to be accepted by the federal government and by most, if not all, provincial governments. **The advantages of attracting foreign investment to Canada for the technology this can bring should be specifically stated in a national science policy.**

As to the Patent Office, we said "the role and mandate of the Patent Office should be changed so it becomes a more useful vehicle for disseminating technical information and encouraging commercialization of useful discoveries." This recommendation should be endorsed as part of a national science policy for Canada.

TECHNOLOGY CENTRES

Government policy in the area of technology diffusion has tended to focus on developing technology centres. **The effectiveness of these centres, the emphasis placed on this policy, how centres are implemented and operated and how they can be better integrated with higher educational facilities should all be seriously questioned in developing a national science policy for Canada.** We understand a review of technology centres is being undertaken by the federal government and we recommend that it address these issues.

EFFECTIVENESS

The purpose of technology centres is to promote technology diffusion by letting companies know about technology and what it can do. But are government technology centres a good source of such information and, perhaps more importantly, to what extent is a lack of awareness about technology a serious impediment to improved technology diffusion? Technology centres are, of course, much less effective for technology transfer than are companies identifying technology opportunities on their own. Studies tend to show that seminars, trade magazine suppliers and many other sources of information not related to government all tend to be much more effective and much more used by companies than government sponsored technology centres. Moreover, small- and medium-sized companies indicate that their major problem in obtaining the technology that they need is generally not a lack of awareness about the technology, but problems in financing

its purchase. Accordingly, government policies aimed at promoting technology diffusion could be more effective if they gave higher priority to helping companies to finance technology purchases rather than to increasing awareness through funding technology centres. For example, the money currently spent on federal and provincial technology centres might be better used in further enriching capital cost allowance provisions.

EMPHASIS

We understand a recent federal study has indicated there are 233 technology centres that are intended to "serve" industry. This number must be put into context to appreciate how these centres have proliferated. Only approximately 1,500 Canadian companies do industrial R&D. This likely represents a good proxy of the companies that will be in a position to benefit from technology centres.

IMPLEMENTATION AND OPERATION

Most technology centres currently operating to serve industry's needs seem to have proliferated more in response to political than to market initiatives. Rather than establishing centres that industry says are needed after industry determines what those needs are, the trend has been for governments to initiate ideas for a centre, get it going and then look for business support or business clients to try and establish, after the fact, that the centre is worthwhile and needed.

A national science policy for Canada should accept there has been an excessive proliferation of technology centres and that many of these are not serving real industry needs. The policy should recommend a "zero-based budgeting" approach to existing centres to look at closing those that are not vigorously and financially supported by sufficient industrial clients to justify their continuation. Coordination of existing centres and overcoming regional restrictions on their use would be a necessary element of such a policy. **Attention should also be given as to whether we need fewer new centres, developed in response to company initiatives, to replace the many existing centres.**

All centres, new or old, should be operated under independent boards of directors that have a majority of business directors. Also, a business plan should be required identifying the industry needs that the centre will serve, outlining how industry initiated the proposal for the centre and showing how self-sufficiency for the centre will be achieved in a given number of years or, if partial government funding will continue to be required, how much and why. **Most importantly, any proposal for new centres should be initiated by their intended private sector clients. This would ensure that centres that are established are centres that industry needs and says it needs, not that government thinks industry needs.**

INTEGRATION WITH UNIVERSITY FACILITIES

Technology centres that are established to assist industry and which are also strongly linked to universities or community colleges can serve a dual role. Besides letting companies know about technology and what it can do, such centres can also be useful for educational purposes. Students can be encouraged to work on industrially relevant projects and thereby gain industrially relevant experience. Also technology centres are often built around very expensive scientific and technical equipment and if this equipment can be used by both business and educational institutions both will benefit.

Cost: If, as part of a national science policy, federal and provincial governments develop a policy for technology centres based on the above recommendations then these centres should cost less and play a much more useful role than they do at present.

GOVERNMENT R&D

Government research has, in the past, often been seen as a source of technology for Canadian industry. The policy was (and to some extent continues to be) that government laboratories, such as the National Research Council or the Department of Communications, for example, would develop technology and transfer it to industry for commercial exploitation. This may be appropriate in certain fragmented industries, such as agriculture, which consist of a larger number of small units, none of which can be expected to do research and technology development. It is not an appropriate strategy for industry generally, however, as industrial technology development should be done in industry, not in government laboratories with a view to transferring the results to industry. Industry laboratories are much closer to the market than government laboratories and success in applying technology in business is directly related to the links researchers have with the marketplace.

CMA recommends that in developing a national science policy for Canada, federal and provincial governments should establish the principle that government should not generally do industrial technology development for the purpose of transferring it to industry.

The role of government laboratories should generally be confined to doing R&D to meet government departmental needs. Even then the government should, to the greatest extent possible, contract- out its research requirements to the private sector and, as a second choice, to universities and other non-government research institutions. Contracting-out to the private sector assists companies to build up research expertise that can later be used in meeting technology development needs the company faces in the marketplace. Contracting-out to universities and other non-government research institutions assists them in establishing expertise that can later be useful when they work with a company to help that company meet its technology development needs.

A series of reports, including the Wright Report, have recommended greater efforts should be made by government laboratories to contract-out their research requirements. Nevertheless, as the Macdonald Royal Commission Report states, "attempts to contract-out government R&D have not decreased R&D done in government laboratories significantly."

If contracting-out policies are to succeed, they should be pursued more vigorously than at present and both federal and provincial governments should agree to do so as part of a national science policy.

For research that continues to be done in government laboratories, we agree with the Wright Report and the Macdonald Royal Commission Report that it needs to be better managed.

Recommendations made in the Wright Report should be implemented to establish "peer review" for government R&D and to establish external board of directors representing the clientele of government laboratories, including the private sector. These recommendations should both be implemented by federal and provincial governments as part of a national science policy for Canada.

Cost: In 1984 federal and provincial governments funded $1,529 million of R&D done in government laboratories (See Table II). Table III shows how the federal

TABLE II

Forecast GERD, by Performing and Funding Sectors, 1984

Funding sector	Performing sector: Federal government	Provincial governments	Business enterprise	Higher education	Private non-profit	Total
	millions of dollars					
Federal government ..	1,344	6	283	396	5	2,034
Provincial governments	—	179	49	126	9	363
Business enterprise ..	—	13	2,123	4	3	2,143
Higher education	—	—	—	472	—	472
Private non-profit	—	—	—	62	41	103
Foreign	—	1	218	10	—	229
Total	**1,344**	**199**	**2,673**	**1,070**	**58**	**5,344**

SOURCE: Statistics Canada, Science and Technology Indicators 1984, Table 3.1

TABLE III

Expenditures on R&D Performed Within the Federal Government, by Department

Department	1977	1978	1979	1980	1981	1982	1983p	1984p
	millions of dollars							
Agriculture	115	126	143	153	178	197	225	264
Atomic Energy of Canada Ltd.	57	68	64	69	82	105	116	123
Energy, Mines and Resources	55	66	64	82	107	136	148	169
Environment[1]	116	60	60	77	84	92	108	115
Fisheries and Oceans[1] ..	—	67	67	75	85	104	111	137
National Defence	62	61	59	72	78	94	94	110
National Research Council	89	102	112	129	152	201	236	293
Other	62	86	77	80	99	113	129	133
Total	**556**	**636**	**646**	**737**	**865**	**1,042**	**1,167**	**1,344**

[1] The Department of Fisheries and Oceans was separated from Environment in 1978

SOURCE: Statistics Canada, Science and Technology Indicators 1984, Table 3.2

government spent its $1,344 million share of this $1,529 million among federal government departments. The Macdonald Royal Commission Report concluded that "government laboratories need better management, not more money." **For a number of reasons we recommend reducing the $1,529 million governments spend on R&D in government laboratories.** First, we have recommended that government laboratories should not generally do technology development work for industry. As their role here diminishes and, in some cases is phased-out, corresponding reductions in funding for government laboratories should result. Second, we have recommended vigorous implementation of the contracting-out policy for government R&D requirements. This should result in less need for R&D in government laboratories and funding should therefore be able to be reduced. Third, if better management of government laboratories is achieved, this should result in cost-savings that can also lead to cuts in funding for government R&D.

FUNDING – DO GOVERNMENTS NEED TO SPEND MORE TO SUPPORT INDUSTRY'S TECHNOLOGY NEEDS?

REALLOCATING EXISTING SCIENCE FUNDING

Our two recommendations to improve university funding to fully fund the costs universities incur in doing business-related research and to strengthen the capability of universities to provide lifetime technical retraining will require reallocations of existing federal and provincial funding for universities and, to the extent necessary, a reallocation of other government expenditures. Our recommendations to improve industrial R&D tax incentives (at a cost we estimate to be $191 million) and to approve NSERC's second five-year plan (increasing the Council's budget by $391 million by 1990) will require $582 million in funding. This required $582 million would be available if government expenditures on R&D performed in government laboratories were reduced to levels closer to those in other OECD countries. As described below, this could free-up $581 million, approximately enough to improve tax incentives and approve NSERC's second five-year plan as we recommend.

These recommendations certainly should be given a higher priority than funding government laboratories if the primary objective of Canadian science policy is to be focused on assisting companies to be able to develop and use technology to improve Canada's competitive position. A substantial reduction in Canadian government spending on government R&D is also clearly suggested if we look at other countries. The share of national R&D performed by government in Canada is 29 per cent while governments in other OECD countries generally perform less than 20 per cent of national R&D (see Table IV at page 16). Reducing Canadian government spending on government R&D to 18 per cent, closer to the OECD norm, would free-up $581 million.

Reallocating funds spent on government performed R&D to implement our recommendations to improve R&D tax incentives and improve funding of university activities important to business needs would not result in Canadian industrial R&D being subsidized or supported excessively by international comparison. For example,

TABLE IV

PER CENT OF NATIONAL R&D EFFORT PERFORMED BY GOVERNMENT	
COUNTRY	PER CENT
U.S. (1979)	14
Japan (1979)	12
Germany (1979)	15
U.K.(1978)	21
France (1979)	24
Sweden (1979)	9
Canada (1984)	29
SOURCE: OECD Science and Technology Indicators, 1984, Graphs 2.C and 3.B and Statistics Canada, Science and Technology Indicators 1984, Table 3.1	

in Table V we estimate that government funding of R&D performed in industry is 20 per cent in Canada, while it is higher in many competing countries, ranging up to 40 per cent in the United States. Canadian industry performs $2,673 million of R&D (Table II at page 14). Canadian government funding of industrial R&D, at a 20 per cent funding level is, therefore, $535 million. If Canadian governments were to match the 40 per cent level of United States funding, federal and provincial governments would provide $1,070 million in support to Canadian industry, a doubling of the $535 million they presently provide.

As the above analysis shows, a very substantial amount of funds could be reallocated to implement the recommendations we make, to fund industry and university technology needs, without any additional government expenditures, if government funding of R&D performed in government laboratories were reduced to levels closer to our OECD competitors. Such a major reallocation would also increase government support of industry's technology development needs to levels closer to those in the United States.

ADDITIONAL FUNDING REALLOCATIONS

Notwithstanding the above analysis, and given the nature of government, any cuts and reallocations in expenditures for government R&D laboratories are likely to be slow and difficult. So too are the reallocations we recommend for existing federal and provincial funding of universities. While these cuts and reallocations may, and should, be sufficient to implement our recommendations, this may not be practical. To the extent this is so, the funding that will be required to implement our recommendations for more university funding and improved R&D tax incentives should come from reallocating other existing government expenditures.

Such additional funding for science policy would be justified. Canada needs to, but does not, match the level of funding provided to support industrial R&D by our competitors. More importantly, increased expenditures to support industrial technology needs for improved R&D funding and more competent technical graduates are demonstrably justified on economic grounds.

To illustrate that Canada does not provide the level of support provided to industrial R&D in other competing countries, CMA has developed Table V. That Table estimates the tax and non-tax support, as a percentage of industrial R&D spending, that is provided to companies in Canada and other competing countries. While limitations on the data that is available do not allow for precise comparisons, Table V clearly shows that support by Canadian governments of industrial R&D is less generous than that available to many of our competitors. The Macdonald Royal Commission Report also comes to the same conclusion that government support for industrial R&D is higher in a number of other countries than in Canada, but qualifies this with the useful observation that the relevant comparisons depend on

TABLE V

TAX AND NON-TAX GOVERNMENT SUPPORT FOR INDUSTRIAL R&D AS A PER CENT OF R&D PERFORMED IN INDUSTRY

COUNTRY	NON-TAX SUPPORT	TAX SUPPORT	TOTAL SUPPORT
U.S.	33%	7%	40%
Germany	18%	6%	24%
France	22%	7%	29%
Canada	12%	8%	20%
U.K.	29%	8%	37%

SOURCE: Percentages for non-tax support of industrial R&D in competing countries were obtained from OECD Science and Technology Indicators, 1984, Tables 2.29 & 3.24 which provide percentages based on 1979 information. The dollar amount of Canadian government non-tax support of industrial R&D and the dollar amount of R&D performed in Canadian industry are available for 1984 from Statistics Canada, Science and Technology Indicators 1984, Table 3.1. The dollar amount of Canadian tax support for industrial R&D for 1982 is available from Macdonald Royal Commission data in Volume II of the Commission Report, Table 8-8. Figures for tax support for other countries are calculated using the amount of 1982 Canadian tax support and ratios that define the relative generosity of R&D tax incentives in Canada and other countries and which were developed by McFetridge and Warda (Canadian R&D Incentives: Their Adequacy and Impact, Canadian Tax Paper, No. 70, Table 5.4). Although the McFetridge and Warda ratios were developed on the basis of tax incentives for R&D support that are different from the incentives available today, the changes in the R&D tax incentives were designed to improve the utilization of the tax incentives and not the level of the incentive. As a result, the estimates in the table can still be considered a useful proxy of the level of R&D tax support provided by various countries today

how you value subsidies that are provided through government R&D contracts as compared to subsidies through grants or tax incentives. The Reports states "if we view a contract as equivalent, dollar for dollar, with a subsidy or a tax credit, then R&D support in the United States, Britain, France, West Germany and Sweden is higher than it is in Canada. If we view a R&D contract as something less than a 100 per cent subsidy, Canadian support comes much closer to the level of those countries." The value of a subsidy provided through an R&D contract will vary with the contract terms and conditions and with the industrial sector.

The fact remains, however, that **there is considerable room for federal and provincial governments in Canada to improve their support of industrial R&D before they can run into the criticism that support for industrial R&D in Canada is excessive by international comparison.**

On economic grounds increased government expenditures are also clearly justified to support industry's needs for R&D funding and for more competent technical graduates. The Macdonald Royal Commission Report notes that a study on industrial strategy done for the Commission establishes that the social return on R&D is much higher than most people realize and supports much more generous funding for industrial R&D in Canada. Other studies have come to the same conclusion. A 1979 Report of the Business Council on National Issues and The Canadian Manufacturers' Association Joint Committee on Industrial R&D in Canada referenced a publication by the National Science Foundation in the United States comparing investment in R&D to the rates of growth in various industries. That study concluded that the rate of return to the United States GNP for every dollar invested in R&D was 30 per cent to 50 per cent. By comparison, an individual company could hope to realize overall rates of return on its industrial R&D investment of only 10 to 17 per cent. **Such economic evidence of the high social rates of return to the economy for industrial R&D investment provides ample economic justification for the expenditures federal and provincial governments would incur in implementing the priority recommendations set out above that we urged be the cornerstone of a national science policy for Canada.**

Appendix I

Cost Implications of Full Refundability and the Provinces not Taxing Federal R&D Tax Incentives

Industry expenditures on R&D performed in industry were approximately $2.1 billion in 1984. (See Table II of this paper.) These expenditures were eligible for investment tax credits of 20 per cent for most companies, 30 per cent for companies operating in specified regions in Canada and 35 per cent for small Canadian-controlled corporations. Based on Department of Finance figures (Table 3, R&D Tax Policy, April 1983) we roughly estimate the 20 per cent credit would apply to 90 per cent of companies and the 35 per cent to the remainder so a weighted average credit would be 22 per cent.

If tax credits were fully refundable this would allow companies not in a taxable position to use their R&D tax incentives when they were particularly needed in periods of no profits. To take the extreme case, in a year when no companies doing R&D recorded a profit so none of them was in a taxable position, fully refundable tax credits would provide from the federal government $462 million to support the $2.1 billion industry spends on industrial R&D. This would be compared to there being no support if the R&D tax credit was not refundable. Full refundability would, therefore, provide stability to R&D tax credits so that at current levels of industrial R&D spending the R&D tax credit would consistently be $462 million and this would not fluctuate with downturns in the economy and the changing financial position of individual companies.

We estimate the cost of full refundability and our recommendation to the provincial governments to stop, in effect, taxing federal R&D tax incentives would be $191 million; $48 million of which would be borne by provincial governments and $143 million by the federal government. These estimates are calculated, based on current levels of industrial R&D expenditures, as follows:

The recommendation for full refundability would mean, at current levels of industrial R&D spending of $2.1 billion, a stable R&D tax credit of $462 million. However, the net cost to government of the $462 million in tax credits is considerably less because the amount of R&D expenditures a company in a taxable position can write off to reduce its taxes is reduced by the amount of R&D tax credits it receives.

Estimates for 1980 by the Department of Finance were that 31 per cent of R&D was done by companies that were not in a taxable position, either because they were not profitable or because of tax incentives they received (Table 7, R&D Tax Policy, April 1983). Assuming this estimate still actually approximates the amount of R&D by taxable and non-taxable companies today, 69 per cent of the $462 million tax credit ($319 million) is already being paid to companies in a taxable position who do R&D and introducing full refundability for companies not in a taxable position (and who do 31 per cent of R&D) would cost the federal government an additional $143 million. By comparison, the May 1985 federal government budget proposals to provide refundability limited to small companies doing R&D will cost $125 million (estimates for 1986-87, Table 3.1, the Fiscal Plan, May 1985). The

extra cost to the federal government of providing full refundability to all companies should, therefore, be only $18 million.

CMA has also recommended that provincial governments stop, in effect, taxing federal R&D tax incentives. This taxation occurs because when the amount of R&D expenditures a company can write off from its taxable income is reduced by the amount of the R&D tax credit it receives, the amount of taxable income subjected to provincial taxation is correspondingly increased. Again, assuming 69 per cent of R&D is performed today by companies in a taxable position, the $319 million in R&D tax credits that such companies receive means a corresponding $319 million increase in their income that is subject to provincial taxation. Assuming a provincial tax rate of 15 per cent, the result is that $48 million of the R&D tax incentives companies now receive from the federal government are siphoned into provincial revenues and do not go to support industrial R&D.

The recommendations that provincial governments stop, in effect, taxing federal R&D tax incentives would, therefore, cost provincial governments $48 million.

These calculations of course depend on the relevance for today of the most recent estimates (made in 1983) by the Department of Finance as to the per cent of R&D performed by taxable and non-taxable companies and these estimates are based on 1980 data. If the per cent of R&D performed by companies in a non-taxable position is greater today than the 31 per cent indicated by the Department of Finance estimates, then the cost would be higher than $143 million for the federal government to implement full refundability and lower than $48 million for the provincial governments to stop taxing federal R&D tax incentives. Conversely, if the per cent of R&D performed by companies not in a taxable position is less today than 31 per cent, then the cost would be lower for the federal government to implement full refundability and higher for the provincial governments to stop taxing federal R&D tax incentives.

Association canadienne de la gestion
de la recherche

DOCUMENT: 830-220/022

LES CONSTITUANTS INDISPENSABLES D'UNE POLITIQUE DES SCIENCES ET DE LA TECHNOLOGIE POUR LE CANADA.
MÉMOIRE À LA
CONFÉRENCE SUR LA POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

June 8-10, 1986
Winnipeg (Manitoba)

Par le Conseil d'administration
de l'Association

Le Canada ne dispose pas d'une politique bien articulée de développement de sa prospérité et de croissance économique, et il faudrait considérer la Politique nationale des sciences et de la technologie comme une partie intégrante de celle-ci. Voici, entre autres, quelques principes vitaux pour la Politique des sciences et de la technologie:

1. Les dirigeants de l'industrie et les autorités publiques devraient être convaincus que les sciences et la technologie constituent des facteurs indispensables à l'accroissement de la prospérité de notre pays.

2. Le secteur industriel est l'élément capital d'une saine politique des sciences et de la technologie favorisant la croissance économique du pays et sa prospérité.Il faut que les produits et les services fournis par l'industrie répondent aux besoins du marché, et que ce soit l'industrie elle-même qui mette sur pied le potentiel technique dont l'efficacité lui permettra de commercialiser les produits fabriqués.

3. La Politique des sciences et de la technologie devrait accroître le pouvoir de concurrence de l'industrie canadienne sur le plan mondial.

4. Il faudrait que les cadres de l'industrie admettent qu'une poursuite dynamique de l'excellence technologique est un facteur crucial de la réussite commerciale.

5. Le développement technologique doit utiliser les points forts de l'industrie canadienne, afin que celle-ci puisse s'ouvrir des créneaux concurrentiels sur les marchés mondiaux, grâce à l'acquisition et au développement de la technologie la plus valable, à la mise au point de produits distinctifs, de haute qualité et à un coût intéressant, en utilisant les ressources du pays, etc.

6. Il est nécessaire de donner une formation adéquate aux futurs dirigeants de notre industrie alors qu'ils sont encore à l'université, afin qu'ils prennent conscience des possibilités offertes par les progrès techniques, et acquièrent les compétences techniques qui leur permettront d'organiser ceux-ci.

7. Il est indispensable de renforcer le rôle le plus important des universités, qui est de former les ingénieurs et les scientifiques qui animeront les programmes de développement technique dans l'industrie canadienne. Sur ce plan, le CRSNG doit jouer un rôle crucial de concertation entre les universités et les entreprises, afin de cerner les objectifs à long terme des programmes de formation.

8. Le financement de la R-D industrielle par l'État constituera un élément capital de la Politique des sciences et de la technologie, ne serait-ce que pour assurer que l'industrie canadienne bénéficie d'un soutien équivalent à celui qu'obtiennent les industries des pays concurrents.

9. Les autorités publiques devraient cesser de pousser au développement des technologies choisies par elles-mêmes pour servir l'industrie, et par la création artificielle d'instituts de développement industriel et de centres d'excellence. De toutes façons, il faudrait s'assurer de la validité de ces organismes en demandant à l'industrie de participer largement à leur financement. Ceux qui ne passeraient pas cette épreuve seraient éliminés graduellement.

10. Les véritables facteurs du succès seront les stratégies scientifiques et technologiques que le Canada décidera d'appliquer. Comme notre pays se trouve en arrière de ses concurrents sur les plans scientifique et technique, il lui faut prendre des décisions stratégiques en tenant compte de <u>toutes</u> les compétences techniques et ressources intellectuelles

dont il dispose. Il est donc indispensable d'établir un couplage entre les secteurs industriel, public et universitaire, afin de développer leur compréhension réciproque et le consensus décisionnel.

11. C'est à long terme que seront recueillis les avantages procurés par les progrès scientifiques et techniques. Il est donc important qu'on entreprenne les actions nécessaires sans autre retard.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

The Vital Ingredients of a Science and Technology Policy for Canada

Canadian Research Management Association

June 8-10, 1986
Winnipeg, Manitoba

PLEASE NOTE

CRMA

MANAGING BOARD

May 23, 1986.

Office of the Minister of State — Cabinet du Ministre d'Etat
28 V 1986
Science and Technology — Sciences et Technologie

The Honourable Frank Oberle
Minister of State for Science
and Technology
235 Queen Street
Ottawa, Ontario
K1A 1A1

Dear Mr. Minister:

Re: Canadian Forum on a National Science and Technology Policy, Winnipeg, June 8-10 (1986)

In response to your letter of April 30, 1986, enclosed are the views of the Management Board of the Canadian Research Management Association in regard to the development of a science and technology policy for Canada.

The Canadian Research Management Association appreciates your invitation to submit our views and looks forward to participation in the Winnipeg Forum and the ongoing dialogue.

Yours truly,

M.P. Bachynski

M.P. Bachynski

/s
Encl.

THE VITAL INGREDIENTS OF A SCIENCE AND TECHNOLOGY POLICY FOR CANADA

Prepared for the "Canadian Forum on a National Science and Technology Policy", Winnipeg, June 8 - 10 (1986)

by

The Management Board of the Canadian Research Management Association

##########

Canada lacks an integrated policy for wealth generation and economic growth. Science and Technology policy must be recognized as an integral part of such an integrated policy for economic development. A number of principles that are the vital ingredients of a science and technology policy include:

1. Management leadership in both industry and government must be committed to the conviction that science and technology are fundamental to increasing the wealth of the nation.

2. The industrial sector is the key to a sound science and technology policy which is fundamental to Canadian economic growth and well being.

   Products and services and therefore technology must be market driven, and the build-up of skills must occur in the industrial sector if it is to be effective since it is industry that must carry the results into the market place.

3. The goal of science and technology policy must be the creation of world competitive businesses.

4. Industry must accept that aggressive pursuit of technological excellence is one of the keys to economic success.

5. Technology development should be built on Canadian strengths to develop niches (for exploitation on a world competitive basis) through acquisition and development of the best technology, developing unique products, high quality products, cost advantages, tying developments to natural resources, etc.

6. There is a need to train our future industrial leaders while they are still students in universities to recognize the potential of technology development and to provide them with the skills to manage this activity.

7. The most important role of universities which is to develop the scientists and engineers who will staff development activities in Canadian industry in the future needs to be strenghtened. In this regard NSERC has a key role as an interface between universities and industries in establishing long term training goals.

.... 2

8. Government funding of industrial R&D will be an essential element of science and technology policy if only to ensure that Canadian industry has the same level of support as that provided in other competing countries.

9. Governments should discontinue their role of developing technology which it independently thinks industry needs. The government is doing this in several ways - by operating its own industry-oriented development laboratories, and by setting up surrogate agencies in industrial development institutes and centres of excellence. In all cases, the true viability of such operations should be tested by having industry share significantly in their funding. Those that fail this test should be phased out.

10. The specific science and technology strategies which Canada decides to pursue hold the real keys to success. Since Canada is currently behind its competitor nations in science and technology, the country must make the strategic decisions using <u>all</u> the available skills and intellectual resources. Close interaction between industry, government and universities as a basis of mutual understanding and consensus building is therefore crucial.

11. The benefits derived from science and technology are long term. It is important that the country proceeds without any further delay.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

A Science and Technology Policy for Canada

The Chemical Institute of Canada

June 8-10, 1986
Winnipeg, Manitoba

THE CHEMICAL INSTITUTE OF CANADA
L'INSTITUT DE CHIMIE DU CANADA

OFFICE OF THE PRESIDENT
BUREAU DU PRESIDENT

110 Bloor St. W., Suite 1001
Toronto, Canada M5S 2W7

May 21, 1986

The Hon. Frank Oberle
Minister of State for science and Technology
House of Commons
Parliament Buildings
Ottawa, ON K1A 0A6

Dear Mr. Oberle:

In response to your letter of April 30, 1986, I accept your kind invitation to attend the "Canadian Forum on a National Science and Technology Policy" in Winnipeg June 8-10,1986, representing the Chemical Institute of Canada.

The Chemical Institute of Canada is an umbrella organization with three Constituent Societies: The Canadian Society for Chemistry; the Canadian Society for Chemical Engineering; and the Canadian Society for Chemical Technology.

Enclosed are the following material outlining my views and those of the Institute:

1. A 1983 CIC position paper on Canadian R & D Investment.

2. A 1984 CSChE submission to the Royal Commission on the Economy.

3. A few personal suggestions toward a science and technology policy for Canada, which have not yet been sumitted to our organizations.

Thank you very much for the invitation to participate in this important forum. I look forward to meeting you in Winnipeg.

Yours sincerely,

W H Rapson

W. Howard Rapson H.F.C.I.C.
President

A SCIENCE AND TECHNOLOGY POLICY FOR CANADA

June 1986

The Chemical Institute of Canada

1. Support for science and technology should be directed to enhance Canada's basic industrial strengths: agriculture; wood products; metal products; petroleum products; high polymer products; transportation machinery; etc.

2. Fundamental research in natural sciences, applied science and engineering should be supported as the foundation on which advances in all those industries are based.

3. A substantially stronger association between industry and university should be fostered in order that each may have a better appreciation of the other. A closer relationship should influence the direction in which research advances and and bring about more rapid application of fundamental research in industry.

4. Fashionable words like "high tech" and "biotechnology" should not be allowed to divert government funds away from our basic industries into areas which have great potential, but can only be expected to have a long term effect. For example, our modern pulp and paper industry is "high technology". It is our largest earner of export dollars.

5. Most fundamental research is carried out in universities. Furthermore, graduate students are the source of highly trained personnel for research and for production in industry. Therefore substantial increase in support for university research should be the foundation for expansion of industrial research.

6. The Natural Sciences and Engineering Research Council has long been the mainstay of university research in this field. The freezing of the government grant to NSERC for five years without even an allowance for inflation in the 1986 budget is a serious blow to university research.

7. While the offer to match grants by industry to support university research is a good concept, it is unlikely to produce substantial funds unless the net cost of such investments by industry are decreased to about 10 cents on the dollar by suitable treatment of corporate income tax. If the rules governing these matching grants are appropriate for encouraging university researchers to seek donors and industries to seek people whose research they want to support they can be of great benefit to the advancement of science and engineering and to industrial expansion in Canada.

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8. The quantity and quality of research published in referreed journals by professors is best judged by peer assessment, as long practiced by NSERC. However, the value of the research for industrial production and sales is best judged by Canadian industries. Companies can influence the choice of research area by making financial contributions to specific university research fields. Informing appropriate departments in universities of the research needs of a company or an industry may influence the research interests of some professors.

9. The Chemical Institute of Canada has for over forty years "helped Canada to develop our intellectual capital", "acquire new knowledge" and "train highly-qualified personnel" through scientific and engineering conferences, seminars and courses. This will continue. We can also establish a portfolio for enhancing this activity.

10. Government laboratories can make a significant contribution to government-industry cooperation in science and technology if their scientists and engineers are required to submit proposals for projects to be financially supported to committees which have a substantial fraction of members from industries. It would help if industries were asked to submit suggestions for projects for government research laboratories.

11. Our educational system does not give most citizens even a modest understanding of the simplest concepts of chemistry, physics and mathematics. This is because the primary school curriculum does not provided it, and the teachers themselves usually do not have it. In the secondary school system, the freedom given to students to choose among many options makes it impossible to ensure that all secondary school graduates understand the basics in these fields. Only by having a set of core subjects that all students must take can this goal be achieved. Fear of things not understood, such as chemicals and radiation, leads to irrational demands which restrict technological advancement.

W. Howard Rapson, H.F.C.I.C.
President

Submission to the Royal Commission on the Economy

The following is the text, exclusive of a few introductory remarks, prepared by the Canadian Society for Chemical Engineering as a written submission to the Royal Commission on the Economic Union and Development Prospects For Canada (the Macdonald Commission) in November, 1983.

Science and Industrial Strategy as an Economic Force

The Canadian Society for Chemical Engineering believes that Canada must have a coherent and comprehensive set of policies and strategies for science and industrial development. Such a framework will provide much-needed impetus to Canada's continued development as a major industrial nation, with increased economic well-being, improved social structure, and lessened regional disparities. Strategies should be formulated by government, industry, labor, educational institutions, and other sectors (including the professional societies) working together under the leadership of the federal government. Representations to the federal government have been made by the society on a number of occasions.

In 1980 the Society surveyed its membership to obtain opinions on the content of an appropriate science and industrial Policy strategy. The results of this survey were provided to the federal government, and were published in the January, 1981 issue of *Chemistry in Canada*. The suggestions are still applicable in today's environment and could have a significant impact on Canada's economic future.

A Canadian Science and Industrial Strategy does not have to be detailed and all inclusive. Rather it should provide broad overall guidelines that all groups with a willingness to take on risks, can strive towards.

The success, however, of any industrial strategy or policy is dependent on a stable economic climate. Every effort must be made to avoid sudden and drastic shifts in Canadian economic policies. Investor uncertainties cannot be tolerated since most of the chemical, process or natural resource development opportunities involve long payout periods. Investor confidence and the perception of a reasonable return on investment for an efficient enterprise is essential for a continued industrial growth.

Undoubtedly there will be a need for policy changes in the face of world and domestic pressures. All parties, the federal government, the provinces, business and the public, should be involved and consulted well in advance of contemplated policy changes. The federal government should coordinate the process to ensure there is an opportunity for input from all concerned parties, to avoid sudden disruptive changes to the economy in general, and to encourage implementation consistent with national social policies.

It is highly desirable that an industrial strategy include guidelines to encourage Canadians to strive towards industrial excellence in a world of growing economic and technical competition. In particular, the Canadian Society for Chemical Engineering advocates a Canadian Science and Industrial Strategy to:

- ensure efficient use of natural resources for maximum Canadian benefit;
- develop a robust secondary industry with emphasis on advanced technology, high growth and high productivity,
- encourage innovation, research and development in Canada;
- strengthen technological education to provide the skills and manpower necessary for these developments;
- utilize industrial development to improve social and ecological well-being.

The Canadian Society for Chemical Engineering believes two components of an industrial strategy are of prime importance. For long term viability, we must see the development of innovative, technically advanced secondary industries, and we must see greatly increased emphasis on the transfer of Canadian (fundamental and applied) research to industry.

Innovative, technically advanced secondary industries provide meaningful jobs for many people, and, because of the high value-added component of their products, contribute favorably to economic growth. Furthermore, there is a benefit to Canada's trade balance if their products are exported. A strong technically advanced secondary industry leads to constant innovation, the development of new products and a lowering of costs. Basic and applied research facilities will grow as a result of the demand from a strong, competitive industry. Only through technically advanced industries will Canada mature into a major industrial power.

The chemical and process industries are examples of technically advanced secondary industries. In Canada, progress has been made and a number of world-scale chemical plants have been built based on methane, ethylene, and ethylene by-products. It is desirable, however, that the boom in basic chemicals be extended to higher value chemical products, such as pharmaceuticals, pesticides, more sophisticated polymers, metal and paper products, and to downstream industries such as plastics fabrication.

The transfer of fundamental and applied research to industry requires major encouragement. Scientific research has been well supported in Canada but the transfer of this research to industry has not. As a consequence, the technology to apply research is often imported. Perhaps further tax incentives and grants will be required to stimulate research and technology advances. In some cases, where there may be fairly long periods before an applied research idea pays out, some provisions for a negative income tax may be appropriate.

In all cases the private sector should play the key role in identifying innovative applied research opportunities. Government and university research laboratories should continue to undertake a significant portion of the basic (pure science) research in Canada. They must, however, become more aggressive in seeking industrial applications for their work in order to reap the greatest economic benefit in the shortest possible time.

POSITION PAPER

CANADIAN R & D INVESTMENT

SUMMARY

A proposal is presented which, through a change in the Federal and Provincial Government taxation system, and provincial resource royalty systems:

increases the incentive for industry to invest in research and development by reducing the net cost to 10¢ on the dollar;

greatly increases the chances that Canada will exceed its R & D expenditure target of 1.5% of GNP over the next five-year period;

through the additional research undertaken over the next five-year period, will generate new industrial sales of approximately $110 billion, and will return future taxes to the various levels of government of approximately $45 billion;

will modernize and revitalize Canada's sagging industrial machine;

will provide incentives for an enriched level of industry/university collaboration;

over the next five-year period, requires the deferment of either $7.0 billion or $3.2 billion (depending on which of two alternative procedures are used) in government taxes and royalties, above that which would apply if the increase in R & D could be attained without a taxation change.

SOMMAIRE

Il s'agit d'une proposition qui, grâce a une modification aux systèmes d'imposition du gouvernement fédéral et des gouvernements provinciaux et aux systèmes de redevances sur les richesses naturelles provinciales:

incite davantage l'industrie à investir dans des travaux de recherche et de développement, en en réduisant le coût net à 10¢ par dollar;

augmente grandement les chances que le Canada dépasse ses dépenses prévues de 1,5% du PNB au chapitre de la R—D, au cours des cinq prochaines années;

générera, au moyen des travaux supplémentaires de recherche entrepris au cours des cinq prochaines années, de nouvelles ventes industrielles de l'ordre de 110 milliards de dollars et des rentrées fiscales d'environ 45 milliards de dollars à tous les paliers de gouvernement;

modernisera et ravivera l'industrie chancelante du Canada;

stimulera un niveau accru de collaboration entre l'industrie et le milieu universitaire;

exigera, au cours des cinq prochaines années, le report d'un montant de 7,0 milliards de dollars ou de 3,2 milliards de dollars (selon celle des deux options qui sera retenue) en impôts et redevances de l'État, montant qui s'ajouterait à celui qui s'appliquerait s'il était possible d'accroître la R—D sans apporter de modification au système d'imposition.

The entire Position Paper by The Chemical Institute of Canada (CIC) summarizing the Institute's concern over a serious Canadian problem is reprinted here for your information.

THE PRESENT SITUATION

Canada historically has had a low level of expenditure on research and development, currently fluctuating around 1% of Gross National Product (GNP) (Figure 1). Since 1.5% of GNP is frequently quoted as a minimum target, by both government and industry, extraordinary measures are required to increase the current level. This paper describes a proposal to accomplish this objective.

THE RELATIONSHIP BETWEEN R & D AND THE ECONOMY

The CIC believes that the health of a country's economy is inextricably linked to technological capability, and this in turn is nourished by the country's capacity and level of excellence in performing basic and applied research and development.

It has been argued that the relationships among basic research, innovation, and industrial activity are too complex to serve as control points for the economy. It has also been argued that R & D alone will not provide the route to a revitalized economy — that unless industry perceives the investment climate to be fair and predictable, simply increasing R & D expenditures will not assure the survival of our industrial machine. These points are all valid and without question. Nevertheless, Canada has had too many examples of companies, and industry segments, which have become obsolete and uncompetitive in the world market place to cast any doubt on the statement that advances in technology through R & D are essential ingredients for the well-being of the country.

Thus, improving the climate for R & D is a necessary step for the revitalization of the Canadian economy. To be effective, however, governments must also provide a positive investment climate, to ensure that the results of R & D are applied for the benefit of the country.

BASIC ASSUMPTIONS

Major and dramatic increases in the level of R & D expenditures by industry, accompanied by the establishment of a more positive business investment climate, are required to revitalize the economy.

This increase in R & D can best be accomplished by an across-the-board incentive scheme available to all companies. Industry is in a position to be selective in choosing research targets and in applying the results. Grants for specific selected research projects should not be used as the method of applying this incentive.

With appropriate consultation with industry groups, university and institutional research capacity should be expanded to ensure that the most modern and efficient scientific tools and concepts are available, and to provide trained specialists.

WHAT'S WRONG WITH THE PRESENT SYSTEM?

The CIC believes that changes are required in the government's method of taxation which currently leaves insufficient cash flow for R & D

Canadian politicians have failed to understand the story about the goose and the golden egg. Governments are too prone to tax wealth before it is formed. The goal of government should be to strengthen Canadian industry to the fullest extent possible, and thus provide a solid profit base for taxation

An appropriate question to ask is whether a tax incentive scheme is fair to the Canadian private taxpayer. The CIC believes that Canadians will benefit more in the future from a technically advanced economy, than they would lose from their support of additional research and development today. In fact,

One can question whether it is fair for the government to tax a company until the company has ensured its survival by instituting an R & D program designed to keep its products and processes competitive. There is ample evidence that the companies who are surviving in today's depressed economy are those who have new products and processes to offer.

VARIABLE CASH FLOW IS A COMPOUNDING PROBLEM

As long as R & D is funded from short term cash flows, Canada's expenditures on R & D will closely mirror the business cycles. This situation gives rise to two problems:

When the economic climate is rosy, aggressive business plans are put in place, but normally there is insufficient time to develop innovative technology. Therefore, R & D programs frequently concentrate on "dressing up" old technology.

When the economic climate is poor, R & D activities are reduced, personnel are transferred, and only short term projects are pursued.

To break this cycle, R & D expenditures must be decoupled as far as possible from short term cash flows.

THE PROPOSED SOLUTION

The solution involves a major increase in R & D, funded through the deferment of current taxes. This increase in R & D would be accomplished by recognizing "grossed-up" values for expenditures on R & D, for the purposes of taxation and royalties. Repayment to the governments would occur through federal and provincial taxes, and provincial royalties, on future improved profits from a technically advanced industry.

THE FINANCIAL SIDE

The cost of R & D to companies operating in Canada, on an after-tax basis, is generally in the range of 25 to 50 cents on the dollar expended. The level depends on the nature of the industry and the position of the company. For example, a company in Alberta which is in a 48.8% taxable position, will be allowed a basic deduction of 100% of R & D expenditures as an ongoing operating cost, such that the net cost would be 51.2 cents on the dollar (neglecting for the moment the investment tax credit). This deduction is available for all operating expenditures, so it does not increase the incentive for carrying out R & D, in comparison to other "investments", such as advertising, etc.

If R & D expenditures exceed the previous three-year moving average, the excess would be allowed a further deduction of 50%, giving rise to a net cost for the incremental expenditures of less than 30 cents on the dollar.

The actual calculations are a little more complex, and are illustrated in the following example: Company spends $1.00 on R & D. Investment Tax Credit = 10%, or 10 cents; Tax Saving = 48.8% (1.00 - $0.10) = 44 cents; Total Tax Credits = 10 + 44 = 54 cents; Net Cost of R & D = $1.00 - $0.54 = 46 cents.

If R & D expenditures exceed the three-year moving average, there is an additional tax credit of 48.8% ($0.50) = 24 cents, yielding an apparent net cost of incremental R & D of 22 cents. (However, the inclusion of the new expenditures in the three-year moving average for subsequent years rapidly removes this incentive.) Many companies have declining R & D programs, and are in the 46 cents/dollar position.

What is needed is a more drastic decoupling of R & D from current year cash flows.

The proposal is to reduce the net cost of investing in R & D to 10 cents on the dollar with a limit placed on any one company, based either on the company's gross revenues or a multiple of its current R & D expenditure level. This 10 cent figure should only apply to funds expended by the company; funds contributed from grants and other financial support programs should be excluded from the calculation.

The level of 10 cents is proposed to provide an "amortization schedule" within the reach of most companies without destroying the discipline of prudent selection of R & D projects. It is The CIC's opinion that a company embarking on a $10 million R & D program will not materially alter its selection criteria whether its net cost is $5 million, or $3 million, or as proposed, $1 million. The question is whether it can provide the funds out of its current year cash flow.

The proposal, then, would be to "gross-up" R & D expenditures by 1.74 which would result in a net cost of 10 cents on the dollar.

If this proposal was accepted, the investor in R & D would be permitted to deduct for purposes of calculating his taxable income 1.64 times his expenditures. This is arrived at by multiplying the actual expenditures by 1.74 and deducting the investment tax credit of 10%. A tax benefit of approximately 80¢ would thus occur (1.64 times tax rate of 48.8%). When the ITC of 10¢ is added, the resulting tax benefit is 90¢ leaving a net cost of 10¢ on the dollar.

Where a provincial royalty rebate is possible, for example in the resource industries, the combined effect of taxation and royalty regulation should be used to obtain the same effect.

THE COST TO THE GOVERNMENT

For the Increased Research

Canada's GNP is in the order of $300 billion. If the program was designed to increase R & D expenditures by 0.1% of GNP per year, each year over a five-year period (a total increase of 0.5%), the financial implication (in 1982 dollars) is shown in Table 1.

The total cost to the government for the additional research is $4 billion. However, the government has indicated that it wishes to exceed the 1.5% of GNP target, so it must already be prepared to provide $2.4 billion of taxable benefits for this purpose. The proposed change in tax treatment requires an additional contribution of $1.6 billion.

To avoid an open-ended commitment by the Federal Government, the program should be designed with an upper limit of new "deferred taxes" for each company and/or industry segment.

For the Existing Level of Research (Preferred Approach)

To obtain the highest level of assurance that the "1.5% of GNP" target is exceeded, The CIC would recommend that the proposed tax treatment be applied to both the existing level of research expenditures and to increased research expenditures.

The maximum additional contribution by Government to the existing level of research would be 36% of the base-line expenditures ($3 billion per year, or $5.4 billion over the five-year period.

The total additional contribution by government to the existing and new R & D would thus be a maximum of $9.4 billion over the five-year period ($4.0 billion + $5.4 billion). The contribution of the proposed tax change to this figure would be $7.0 billion ($1.6 billion + $5.4 billion).

For the Existing Level of Research (Alternative Approach)

If the above described treatment is beyond the financial capability of government, our alternative approach would be to permit companies who increase their research effort to apply the proposed tax treatment to their existing level of research to an amount equal to the increased expenditure (in effect, a mirror image of the increased expenditures).

For example, a company which presently conducts $2 million per year of R & D, and which increases its expenditures to $3 million, would receive the following tax treatment:

First $1 million: Net Cost = $0.46 million
Second $1 million: Net Cost = $0.10 million
Third $1 million: Net Cost = $0.10 million
Total Net Cost: = $.0.66 million

TABLE 1

Year	Total New R & D $ Billion	Gov't. Contrib. Under Existing Tax Laws* $ Billion	Additional Gov't Contrib. Under Proposed Tax Laws* $ Billion	Total Gov't. Contrib $ Billion
1	0.30	0.16	0.11	1.27
2	0.60	0.32	0.22	0.54
3	0.90	0.49	0.32	0.81
4	1.20	0.65	0.43	1 08
5	1.50	0.81	0.54	1.35
Total	4.50	2.43	1.62	4.05

*Assuming the existing benefit is 54% and the new benefit is an addition 36%.

The total contribution by government to the increased R & D expenditures ... its new contributions to the "mirror image" would be $5.6 billion ($4.0 billion + $1.6 billion). The contribution of the proposed tax change would be $3.2 billion ($1.6 billion + $1.6 billion)

This proposal has the characteristic that only those companies who are willing to expand their research effort would be allowed to apply the proposed tax treatment to their continuing level of research expenditures. The proposal has the serious disadvantage that it offers nothing to those companies who are currently having cash flow problems and who are having difficulty maintaining their existing level of R & D.

THE BENEFITS

The literature on the benefits of R & D to the economy is extensive, and has been well summarized by Gauvin[2] Rates of return from investments in R & D reported in most studies are above 20%, and frequently much higher (The rates of return from individual successful projects are considerably higher, as these projects must cover the costs for unsuccessful R & D activities.)

What is the return to the country, resulting from the pumping of an additional $4.5 billion into R & D for the next 5 years? Although such forecasts are of necessity imprecise, The CIC has calculated the expected benefits using the most reliable information available (see Table 2).

Industry is the first beneficiary in being able to keep its plant and products competitive and in not losing ground in the export marketplace. Various studies have indicated that for every dollar invested in R & D, $25 are generated in future sales. The total sales resulting from a $4.5 billion investment in R & D is, therefore, in the order of $110 billion.

Governments also benefit from the revitalized industry, and studies have shown that an investment of one dollar in R & D provides $10 in direct taxes to the various levels of government. Thus the governments would receive $45 billion in direct taxes from the $4.5 billion investment in R & D.

In summary, The CIC believes the following benefits would occur if its proposal is adopted:

Industry sales would increase by $110 billion
Governments would receive approximately $45 billion in additional direct revenues.

It should be stressed again, however, that these benefits will only accrue if the Government provides a favorable down-stream investment climate. The results of R & D must be commercialized to generate the returns described above.

[2]*Contributions of Research and Development to Economic Growth,* W.H. Gauvin, Chemistry in Canada, May 1981, p. 14-26.

TABLE 2
Benefits from R & D Investments[1]

Investment in R & D	$100
Existing taxation benefit	$ 54
New proposed taxation benefit	$ 36
Return on investment @ 25%	$ 25/yr.[2]
Sales generating above return	$250/yr.[3]
Life of R & D innovation	10 years[4]
Total sales generated	$2500
Ratio of sales generated to R & D investment	25
Estimate of direct returns to governments	$1000[5]
Ratio of direct returns to governments	
: to R & D investment	10
: to total tax benefit	11
: to new proposed tax benefit	28

1. Following method of Gauvin, Chemistry in Canada, May 1981.
2. A conservative estimate of return on R & D investments, based on various studies in the U.S. and elsewhere.
3. Assuming 10% profit on sales.
4. An arbitrary estimate of life of innovation resulting from R & D, frequently considerably in excess of 10 years.
5. Direct returns to Federal, Provincial, Municipal governments over ten-year period for income tax on salaries, federal and provincial corporate taxes, sales taxes, etc.

This CIC position paper was submitted to the Minister of State for Science and Technology, Donald Johnston and the Minister of Finance, Marc Lalonde. A copy has been sent to each MP and to key people in the chemical industry.

It is important that you the individual member emphasize to the cabinet ministers, opposition science critics and your local MP's and MLA's the importance of Canadian investment in R & D. Contact them without delay.

The Hon. Donald J. Johnston, Minister of State for Science and Technology, 270 Albert St., Room 1400, Ottawa, ON, K1A 1A1, 613-996-0326.

Gordon Gilchrist, Progressive Conservative Spokesman for Science & Technology, Room 172, Centre Block, Parliament Buildings, Wellington St., Ottawa, ON, K1A 0A6, 613-995-7485; Constituency Office: 3464 Kingston Rd., No. 206, Scarborough, ON, M1M 1R5, 416-264-3241.

Simon de Jong NDP Science Spokesman, Room 914, Centre Block, Parliament Buildings, Wellington St., Ottawa, ON, K1A 0A6, 613-992-4593. Constituency Office, 164 Broad St. N., Regina, SK, S4R 2X5, 306-352-9144.

INCENTIVE FOR NON-TAXABLE COMPANIES

New innovative companies, who are not yet in a taxable position are highly productive in R & D activities and would not benefit from income tax deferment. However, the government applies many other forms of taxation, such as excise taxes and the recently imposed petroleum and gas revenue tax (PGRT), to which R & D abatements could be applied. Direct cash rebates to companies who are not in a taxable position is another possible mechanism.

As previously mentioned, reductions in provincial royalties, which are related to sales rather than profits, should also be introduced.

The net effect should be to reduce the cost of carrying out R & D to 10 cents on the dollar for all companies.

UNIVERSITY/INDUSTRY COLLABORATION

To strengthen interaction between Canadian industry and universities, it is proposed that companies who contract R & D work to universities also be allowed to "gross-up" such expenditures. This should enable small companies, who cannot undertake R & D programs on their own, to undertake research activities at low cost.

Companies in the United States have benefited by making large unstructured R & D grants to universities, with a sharing of license income resulting from the R & D effort. Canada could encourage this by allowing such grants to qualify for the proposed taxation treatment.

THE OBLIGATIONS OF INDUSTRY

As its part of the bargain, industry should:

Commercialize the technology as rapidly as market conditions permit, or if not, license the technology immediately under fair market value terms.

Vigorously pursue international opportunities for marketing Canadian expertise, equipment and products resulting from the incentive program.

L'INSTITUT DE CHIMIE DU CANADA

UNE POLITIQUE CANADIENNE DES SCIENCES ET DE LA TECHNOLOGIE

Juin 1986

SOMMAIRE DES RECOMMANDATIONS

1. Il faudrait orienter le soutien des activités scientifiques et techniques de façon à développer les points forts de l'industrie canadienne: secteur agricole, secteur du bois, branches des produits métalliques, des produits pétroliers, des plastiques hauts polymères, du matériel de transport, etc.

2. Il faudrait financer les recherches fondamentales dans les sciences naturelles, les sciences appliquées et l'ingénierie, car elles fournissent les fondements des progrès de ces secteurs et branches industrielles.

3. On devrait encourager un notable resserrement de la collaboration entre les entreprises industrielles et les universités, afin que chaque intéressé connaisse mieux les caractéristiques de son partenaire. Ces relations plus étroites permettraient d'orienter les progrès des recherches et d'accélérer la mise en oeuvre industrielle des résultats de la recherche fondamentale.

4. Les expressions à la mode telles que "technologie de pointe" et "biotechnologie" ne doivent pas contribuer à détourner le financement du développement de notre industrie de base vers des initiatives pleines de promesses, mais réalisables seulement à long terme. Notre industrie moderne des pâtes et du papier utilise aussi une "technologie de pointe", et c'est cette industrie qui fait la plus forte contribution à notre balance commerciale.

5. La plus grande partie de l'effort de recherche fondamentale est accompli par les universités. De plus, les étudiants des 2^e et 3^e cycles constituent le bassin de spécialistes de haute qualification dans lequel l'industrie puisera pour ses activités de recherche et de fabrication. C'est pourquoi l'expansion de la recherche industrielle nécessite un accroissement substantiel du soutien à l'effort de recherche universitaire.

6. C'est le Conseil de recherches en sciences naturelles et en

génie qui, depuis longtemps, a été le soutien principal de la recherche universitaire en ce domaine.Le plafonnement des subventions de l'État au CRSNG pendant cinq années, sans même que le budget de 1986 ne prévoie une indexation pour contrebalancer l'inflation, constitue une entrave sérieuse à la recherche universitaire.

7. Bien qu'en elle-même l'idée d'un cofinancement de la recherche universitaire par l'industrie soit valable, elle ne procurera des fonds substantiels aux chercheurs que si le coût effectif de cette aide n'atteint qu'environ 10 pour cent de son montant pécuniaire, grâce à des déductions permises par la loi de l'impôt sur le revenu des sociétés. C'est quand les règles régissant ce cofinancement encourageront les chercheurs universitaires à solliciter les donateurs éventuels et les entreprises à rechercher des programmes de recherche à financer, qu'elles favoriseront fortement le progrès des sciences et de l'ingénierie, et l'expansion des activités industrielles au Canada.

8. L'ampleur de la recherche accomplie par les chercheurs-enseignants et la qualité des résultats qu'ils publient dans les revues scientifiques avec comité de lecture sont évaluées très exactement par leurs pairs, comme le CRSNG y procède depuis longtemps. Par contre, ce sont les entreprises industrielles canadiennes qui sont les meilleurs juges des résultats de la recherche visant à développer la fabrication et le chiffre d'affaire de l'industrie. Les entreprises peuvent encourager les recherches dans les disciplines qui les intéressent en leur accordant un soutien financier particulier. L'entreprise ou la branche industrielle désireuse d'y attirer des chercheurs-enseignants doit en informer les directeurs des départements universitaires concernés.

9. Pendant plus de quarante années, l'Institut de chimie du Canada a "aidé notre pays à accroître son capital intellectuel", "à recueillir de nouvelles connaissances" et "à former des des spécialistes de haute qualification", grâce à des conférences,

des séminaires et des cours portant sur les sciences et l'ingénierie. Ces activités seront poursuivies, et l'Institut pourra réunir un portefeuille en vue de les développer.

10. Les laboratoires du secteur public peuvent faire une importante contribution à la collaboration entre l'État et l'industrie sur les plans scientifique et technologique, en exigeant que leurs scientifiques et leurs ingénieurs présentent des projets de recherches à financer à des comités dont une partie notable des membres appartiennent au secteur industriel. L'élaboration de ces projets serait facilitée par les indications pertinentes que l'industrie fournirait aux laboratoires de l'État.

11. L'appareil scolaire de notre pays ne donne même pas, à la plupart de ses citoyens, une compréhension modeste des éléments fondamentaux de la chimie, de la physique et des mathématiques. La raison en est que le programme de l'enseignement primaire ne s'en occupe pas, et que ses enseignants, en général, n'ont pas cette compréhension. Dans l'enseignement secondaire, la liberté de choix des élèves entre de nombreux cours fait qu'il est impossible d'assurer à tous la connaissance des fondements de ces disciplines. Ce n'est que par la création d'un tronc commun de cours obligatoires qu'on pourrait atteindre cet objectif. Les phénomènes mal compris, comme le comportement des produits chimiques ou des substances radioactives, engendrent des craintes irrationnelles qui bloquent le progrès technologique.

le Président de l'ICC
W. Howard Rapson

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Brief Summary Statement

Corporate-Higher Education Forum

June 8-10, 1986
Winnipeg, Manitoba

CORPORATE-HIGHER EDUCATION FORUM

1155 Dorchester Blvd. West
Suite 2501
Montreal, Quebec H3B [illegible]
(514) 876-1356

May 23, 1986

The Honourable Frank Oberle
Minister of State for
Science and Technology
240 Sparks Street
C.D. Howe Building, 8th Floor
Ottawa, Ontario K1A 1A1

Dear Mr. Minister,

In response to your letter of invitation to attend the Canadian Forum on a National Science and Technology Policy, I am pleased to respond that the Corporate-Higher Education Forum wishes to be represented by Don Assaff.

Mr. Assaff presently is serving as Vice President, Research Policy at the Corporate-Higher Education Forum, on half-time secondment from Bell Canada. Prior to this special appointment, he was Project Director of the Forum's Task Force which under the chairmanship of J.V. Raymond Cyr produced the report Spending Smarter. His secondment from Bell was intended to facilitate followup of the initiatives and recommendations proposed in that study. The position which he continues to hold with Bell Canada is that of Director of University Liaison.

In keeping with his dual responsibilities as described above, Mr. Assaff will serve as both representative of the Forum and spokesman for J.V. Raymond Cyr, Chairman and Chief Executive Officer of Bell Canada, who also was invited to attend your gathering. In both cases, he will enunciate the positions taken in Spending Smarter.

Attached please find a brief summary statement which the Forum wishes to put on record for your meeting.

We are encouraged by your statement that "the results of the Forum will be central in developing federal policy", and appreciate this opportunity to contribute to the process of defining your goals and activities for coming decades.

Yours sincerely,

Patricia Roman

Patricia Roman
Vice President

cc: Raymond Cyr, Bell Canada
John Gundy, MOSST

FORUM

The following summary statement represents the position of the Corporate-Higher Education Forum, and of Bell Canada's Chairman and Chief Executive Officer J.V. Raymond Cyr in his role as Chairman of the Forum's Task Force which produced the report Spending Smarter (Investir plus sagement) in October 1985.

FORUM

The following summary statement represents the position of the Corporate-Higher Education Forum, and of Bell Canada's Chairman and Chief Executive Officer J.V. Raymond Cyr in his role as Chairman of the Forum's Task Force which produced the report Spending Smarter (Investir plus sagement) in October 1985.

Introduction

In the fall of 1984, the Corporate-Higher Education Forum published its first major study Partnership for Growth: Corporate-University Cooperation in Canada. As a result of that research project, the Executive Committee established a Task Force of members to examine in more detail one of the issues identified for further action: the research and development required for the innovations that are expected to play such a significant role in ensuring the competitiveness of Canadian industry in coming years.

Spending Smarter is a result of that work. We believe that the following summary of its findings will be of interest to this National Science and Technology Forum and, we hope, to the country as a whole.

Summary

The picture of Canadian research and development investment patterns that emerged in Spending Smarter suggests that improved cooperation between universities and corporations represents a genuine and substantial opportunity for Canada to deploy its research and development (R&D) resources more effectively, and that this opportunity should be exploited aggressively.

Universities and corporations alike believe that cooperative R&D can offer substantial benefits in a variety of forms. Universities recognize that such cooperation can yield not only additional research resources but also new intellectual challenges which can result in society-wide benefits through the application of research. These add up to a more exciting and challenging environment for teachers and students which in turn leads ultimately to better educational programs.

Corporations recognize that better educational programs mean better graduates, leading in turn to greater competitiveness both within Canada and globally. They also recognize that universities are an excellent and convenient source of technological expertise, which they either cannot afford to develop in-house or cannot justify as a permanent department.

Canada's economy also benefits substantially in that university R&D is a key source of the technological advances that protect our existing industries - challenged as they are by cheap labour and other resources in developing countries - while creating new jobs in the new industries such technological advances spawn. Outstanding examples of job-creation arising from technological achievement in major universities and corporations exist today in the United States and the United Kingdom. In Canada we are only beginning to reap such benefits; Kanata is, perhaps, our leading example.

All these benefits suggest that cooperative R&D offers a significant opportunity to improve Canada's sub-standard performance in the worldwide R&D stakes. (Canada's R&D spending has stalled at about 1.5 percent of gross domestic product - consistently below the levels in other developed countries.) Cooperative R&D also offers an opportunity to overcome, at least in part, the serious shortcomings in government research spending (which consumes a disproportionately large share of Canadian R&D dollars). Although government-funded research has resulted in some technological advances, many believe that research performed in government laboratories has contributed little to the advancement of Canada's economic competitiveness, either because of poor project selection or because of poor transfer of results into the commercial arena.

Despite perceptions of the important benefits which are available through cooperative R&D, activity is limited. Spending Smarter confirms the view that there are two major barriers; one cultural, the other logistical. "Cultural barrier"

relates to the differences between the academic and corporate communities in terms of R&D goals, ways of doing things, attitudes toward time and budgets, and definitions of success. The "logistical barrier" refers to the practical difficulties researchers in both communities encounter in identifying and communicating with their counterparts to initiate cooperative activity.

On a more positive note, the members of the Task Force found that cooperative R&D was being conducted to the satisfaction of both univesity and corporate participants. Two conditions appear to be necessary if such healthy cooperation is to continue to flourish and grow. First, leaders on both sides must create a more supportive environment, within which it is easy to deal with cultural or institutional differences. Second, organizations must invest the time and money to get researchers talking to researchers. Talking leads to specific project opportunities - and that is the payoff.

There is growing evidence that the climate is right for cooperative R&D to flourish. A consensus is emerging that there will be a tilt back toward basic research - the forte of the university - as corporations recognize the limitations inherent simply in seeking further refinements of existing technologies. At the same time, there is a growing recognition among academics that working with corporations does not necessarily imply an erosion of independence and integrity; even in the most intensely active cooperative relationships, contract work accounts for only a small percentage of a university's overall research budget.

The report does not mean to play down organizational barriers. Some are so deeply entrenched, with solutions so radical to an organizations's culture, that only leadership intervention will change things. Motivating researchers on both sides would be a beginning. At present, cooperative R&D is not likely to do much to enhance the career of a researcher on either side. Basic changes in evaluation systems are necessary to remove this barrier.

The report encourages Canadian governments to act as a source not only of money but also of ideas for both corporations and universities. It suggests, for instance, that:

- The government should re-examine its policies along two broad lines -- its own direct spending on R & D; and its tax and direct grant policies in support of research and development done outside government;

- It should sub-contract more of the research being performed in its own laboratories;

- More should be done to ensure that government research results find their way systematically and efficiently into the commercial sector.

The Task Force felt too that government should revise its tax incentives, university funding and block grants to take into consideration:

- Small companies, which badly need R & D but which, for a variety of reasons, cannot benefit from tax incentives;

- The need for universities to be given some incentive to cooperate actively with corporations;

- The encouragement of universities and corporations to increase their professional competence in specific, relevant areas of research; and

- The need to address Canada's research talent shortfall.

Conclusion

This Forum for the Development of a National Science and Technology Policy stresses the importance of developing and acquiring new knowledge. The Corporate-Higher Education Forum in its study Spending Smarter proposes ways of developing and acquiring new knowledge more effectively through closer collaboration amongst universities, corporations and governments.

DOCUMENT: 830-220/024

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Déclaration Sommaire

Forum entreprises-universités

le 8-10 juin 1986
Winnipeg (Manitoba)

FORUM

Le sommaire qui suit résume la position du Forum entreprises-universités et de M. J.V. Raymond Cyr, président du Conseil et chef de la direction de Bell Canada. M. Cyr a présidé le Groupe de travail qui a produit le rapport intitulé Investir plus sagement en octobre 1985.

Introduction

À l'automne 1984, le groupe Forum entreprises-universités a publié sa première étude importante : **Ensemble vers l'avenir : la collaboration entreprises-universités au Canada** . Par suite de cette recherche, le comité exécutif a mis sur pied un groupe de travail dont la mission était d'examiner en détail un des points désignés pour faire l'objet d'une action future : la recherche-développement. Celle-ci, en effet, est essentielle pour susciter les innovations dont le rôle sera si important pour assurer la compétitivité de l'industrie canadienne dans les années futures.

Le rapport **Investir plus sagement** est le résultat de ce travail. Nous croyons que le résumé de ses conclusions retiendra l'attention de la Conférence nationale sur la politique scientifique et technologique, car elles intéressent notre pays tout entier.

Résumé

Le tableau des types d'investissement en recherche-développement que révèlent **Investir plus sagement** souligne qu'une meilleure collaboration universités-entreprises constitue pour le Canada une occasion réelle et importante de déployer plus efficacement ses ressources R-D et que toute l'énergie possible devrait être consacrée à cette tâche.

Les universités et les entreprises croient que la collaboration en R-D comportent des avantages importants et variés. Les universités reconnaissent que la collaboration, en plus d'apporter des ressources additionnelles pour la recherche, offre aussi de nouveaux défis intellectuels et que la société toute entière bénéficie des résultats pratiques de la recherche. Tous ces avantages s'additionnent pour créer un milieu stimulant pour les professeurs et les étudiants et déboucher finalement sur de meilleurs programmes d'études.

Les entreprises reconnaissent que de meilleurs programmes d'études créent de meilleurs diplômes, ce qui conduit à une plus grande compétitivité au Canada et dans le monde entier. Elles reconnaissent aussi que les universités constituent une source excellente et pratique d'experts en technologie qu'il est trop onéreux pour l'entreprise de former elle-même ou qui ne justifient pas la création d'un service permanent à cette fin.

L'économie canadienne retire également des avantages importants de la collaboration, car la R-D universitaire est une source clé d'évolution technologique qui protégera nos industries actuelles, déjà mises au défi par la main-d'oeuvre et les autres ressources moins coûteuses des pays en voie de développement, tout en créant de nouveaux emplois dans les industries nouvelles engendrées par ces mêmes progrès technologiques. Des exemples frappants de création d'emplois nés de réussites technologiques dans des universités et entreprises importantes existent déjà aux Etats-Unis et au Royaume-Uni. Au Canada, nous ne faisons que commencer à sentir de tels résultats; Kanata en est peut-être le meilleur exemple.

Compte tenu de tous ces avantages, la collaboration en R-D constitue un moyen important d'améliorer la performance médiocre du Canada face aux enjeux mondiaux en R-D. (Les dépenses du Canada en R-D sont restées figées à 1,5 % du produit intérieur brut, sans jamais approcher des niveaux observés dans les autres pays industrialisés.) Une telle collaboration nous fournit aussi l'occasion de remédier, du moins en partie, aux graves carences de la R-D financée par l'État (qui consomme une proportion beaucoup trop grande des sommes investies en R-D au Canada). Bien que les recherches financées par le gouvernement aient donné lieu à un certain progrès technologique, beaucoup croient en effet que la recherche effectuée dans les laboratoires du gouvernement a peu contribué à accroître la compétitivité économique du Canada, soit en raison du mauvais choix des projets ou du peu de succès à transposer les résultats dans l'arène commerciale.

Malgré les avantages importants qu'offre la collaboration en R-D, le niveau d'activité demeure limité. **Investir plus sagement** confirme l'existence de deux obstacles importants, l'un culturel, l'autre logistique. On entend par barrière culturelle la différence entre les objectifs de R-D des deux groupes, entre leurs façons de procéder, leurs attitudes face au temps et aux budgets, et le sens que chacun donne à la notion de succès. La barrière logistique est constituée des difficultés pratiques que les chercheurs des deux groupes éprouvent à trouver qui sont leurs homologues de l'autre groupe et comment entrer en contact avec eux lorsqu'ils veulent lancer une activité en collaboration.

Cependant, les membres du Groupe de travail ont constaté qu'il se faisait entre universités et entreprises de la R-D en collaboration dont les participants étaient satisfaits. D'après les observations du Groupe de travail, deux conditions sont essentielles pour que cette saine collaboration se maintienne et puisse s'accroître. Premièrement, les dirigeants des deux groupes doivent créer un milieu plus propice qui permettra de mieux concilier les particularités culturelles et institutionnelles. Deuxièmement, les entreprises et les universités doivent investir temps et argent pour amener les chercheurs à communiquer entre eux, car ce genre d'échanges débouche sur des occasions de recherche et c'est là le but visé.

Il existe plusieurs preuves que le climat est actuellement propice à l'augmentation de la collaboration en R-D. On voit poindre un consensus vers un retour à la recherche fondamentale - où excelle l'université - au fur et à mesure que les entreprises reconnaissent les limitations d'une recherche axée seulement sur le perfectionnement des technologies existantes. En même temps, le monde universitaire se rend de plus en plus compte que la collaboration avec l'entreprise ne suppose pas nécessairement l'érosion de son indépendance et de son intégrité, parce que, même dans la relation de collaboration la plus intense, le travail contractuel ne compte que pour un faible pourcentage du budget global de recherche des universités.

Les auteurs du rapport ne veulent pas minimiser l'importance des barrières propres aux diverses organisations. Certaines sont si solidement ancrées et les solutions si radicales pour les sensibilités de chacun des groupes que seule l'intervention des dirigeants peut modifier la situation. On se rend compte, par exemple, que les chercheurs de l'un ou l'autre groupe ne sont pas motivés outre mesure par la collaboration en R-D, car elle n'aide en rien leur carrière, et qu'il faudra modifier profondément les systèmes d'évaluation pour supprimer cet obstacle.

Le rapport incite les gouvernements à n'être pas qu'une source de financement, mais également une source d'inspiration pour les entreprises et les universités. Les auteurs du rapport estiment, par exemple :

o que les gouvernements devraient réexaminer deux aspects de leurs politiques, à savoir : leurs propres dépenses de recherche et développement,

et leurs politiques fiscales et leurs politiques de subventions de la recherche-développement poursuivie en dehors de leurs structures;

o qu'ils devraient confier à la sous-traitance une plus grande partie de la recherche qui est actuellement poursuivie dans leurs laboratoires;

o qu'ils devraient chercher plus activement des moyens efficaces et systématiques de commercialiser les résultats de leurs recherches.

Le Groupe de travail a également recommandé que le gouvernement réévalue ses stimulants fiscaux, ses subventions aux universités et ses diverses subventions globales, et qu'il se penche notamment sur :

o Le problème des petites entreprises, qui ont des besoins pressants en matière de R-D mais qui, pour diverses raisons, ne bénéficient pas de stimulants fiscaux;

o la nécessité d'accorder des stimulants aux universités qui collaborent activement avec les entreprises;

o la nécessité également d'inciter les universités et les entreprises à accroître leurs compétences professionnelles dans des secteurs de recherche pertinents; et

o la nécessité de se pencher sur le manque de compétences en recherche au Canada.

Conclusion

La Conférence nationale sur la politique scientifique et technologique souligne l'importance de l'acquisition et du perfectionnement des nouvelles connaissances. Dans son étude intitulée **Investir plus sagement,** le Forum entreprises-universités propose des façons d'y parvenir plus efficacement en misant sur une étroite collaboration entre les universités, les entreprises et les gouvernements.

DOCUMENT: 830-220/025

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Summary of a Paper Entitled Creating the Science Environment

Electrical and Electronic Manufacturers Association of Canada

June 8-10, 1986
Winnipeg, Manitoba

Electrical and Electronic Manufacturers Association of Canada

One Yonge Street, Suite 1608, Toronto M5E 1R1

May 22, 1986

The Honourable Frank Oberle
Minister of State for Science and Technology
House of Commons
Ottawa, Ontario
K1A 1A1

Dear Minister,

On behalf of the members of EEMAC, I thank you for your cordial reception of our R & D Committee members at your office on May 7. The ensuing discussion was, I believe, mutually beneficial.

At that time we presented you with our paper entitled "Creating the Science Environment". Attached to this letter is the four-page condensation that was requested for inclusion in the material for the Winnipeg Conference on June 8. EEMAC will be represented at the Conference by Dr. George Yan, Vice President, Engineering, Phillips Cables Limited, who is also a member of our R & D Committee.

Yours sincerely,

Ernie Welling
Manager, Electronics Divisions

EAW/lb

Attach.

Electrical and Electronic Manufacturers Association of Canada

One Yonge Street, Suite 1608, Toronto M5E 1R1 Tel. (416) 862-7152 Telex 0623189

SUMMARY OF A PAPER ENTITLED CREATING THE SCIENCE ENVIRONMENT - MAY 1986

INTRODUCTION

The federal government's Science Policy, and its commitment to a policy, is a crucial concern of industry. Since the importance of this matter has largely had lip service over the years, we feel that a concommitant to the announcement of a policy would be some means of assuring for it the priority that is attached to major initiatives. Strong support and representation at the highest level is needed to create the emergence of Canadian engineering and science as a driving force in the economy.

A Science Policy should not address itself solely to pure research. The directions taken in industrial research and development policy will be crucial to Canada's international trade performance, especially as we progress to a free trade environment.

Increasingly, Canada's economic well-being and the standard of living of our people will depend, not only on our declining natural resources, but on our ability to compete, both at home and abroad, in technology and knowledge-based industries.

INDUSTRIAL RESEARCH AND DEVELOPMENT

The Electrical and Electronic sector is a heavy R & D spender relative to most industries but obviously its expenditure is still not enough to ensure its own future health. In 1984 many companies in the sector spent over 4% of gross revenue on R & D - more than triple the national average. Other companies in this sector experiencing strong growth are spending in excess of 5% and up to 20% of gross revenue.

To bring R & D spending even up to the 5% level across the sector is not realistically possible without substantial public support, particularly in

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enabling technology contracts*. The enabling technology contract is an attractive solution since it could be coupled with a redistribution of government R & D expenditures.

An effective R & D strategy must be comprehensive and must complement the entire manufacturing and marketing process. Industrial R & D <u>must</u> be market-driven, constantly evolving to satisfy ever-changing international and domestic requirements.

ENABLING TECHNOLOGY

One of the main reasons that government support to industrial development is lower in Canada than in some other industrialized countries is because major programs do not take place under government contract where the development of industrial capability is seen as a major and necessary component of the investment. In other industrial countries with which we compete, non-tax support represents as much as 33% of industrial R & D. In Canada, it is about 12%.

This is clearly an opportunity that we are missing in Canada. Government contracts are often placed on a very competitive basis where no allowance can be made for the substantial development costs that may be required to create that particular manufacturing capability in Canadian industry. The funding of these kinds of development costs under such major contracts is widely practiced in other countries, does not attract the attention that grants or tax incentives do, and is not considered unfair competition.

Canada must make better use of government purchasing power to build technical industries. Development work and technology contracts should go to industry - not government labs.

INCENTIVES, PROCUREMENT, AND GRANTS

About 16 cents of every industrial sales dollar is deposited in government coffers in the form of Federal sales tax, income tax, and corporate tax,

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*These are contracts where the only deliverable is a demonstration of technological capability.

whereas secondary manufacturing industry, on average, retains earnings of about 4 cents. With such an uneven partnership, industry depends heavily on government to take a significant part in its ongoing development, particularly in respect to research activities and the application of scientific developments. Such government participation is widely practiced in the OECD countries but has yet to achieve similar levels in Canada.

As part of government's cooperative role with industry, we believe that this assistance can be provided in five ways:

A. Through contracts for the supply of technological capability.

B. By direct grants.

C. By providing tax incentives for research and development.

D. Government Procurement.

E. Mechanisms directed to companies which are not sufficiently profitable to realize tax credits.

Tax incentives are usually not as beneficial as they seem because of taxation. Changes must be made to the Income Tax Act to allow the full value of incentives to be realized. Provincial governments must give up their windfalls from the taxation of federal R & D incentives or, instead, provide some offsetting benefit to R & D performers in their province.

INVESTMENT CAPITAL

To achieve substantial industrial growth in the next decade, industry requires large amounts of investment capital from corporations and individuals. For small, fast-growing companies this is often a serious problem. It could be solved by a national stock savings plan similar to that adopted by Quebec, with a sliding scale of tax write-offs for investors.

MANPOWER DEVELOPMENT

A new covenant must be struck between the universities and business. The basis

for the new covenant should be the provision of industrial experience for university staff, university exposure for industrial staff, and a re-emphasis of the fundamentals in university education.

While additional funding may be helpful, it would not reach the core of the issue. An adequate amount of Canada's Gross National product is being devoted to the education system at present. Canada spends a greater portion of its national wealth on education than any of its major industrial competitors. Rather, the allocation of these resources within the system must be corrected as must the ability of the system to meet change.

We believe that strategic planning is the approach required for educational reform and that a strategy for technical education and skilled manpower development must be created that is consistent with a National Science Policy. Strategic planning should address issues such as faculty renewal, capital expenditures, emphasis on key areas such as engineering and computer science, a market-type system for funding universities, and methods to create greater adaptability.

We believe also that there is a level of technological illiteracy, with its roots in the high schools, being propagated through the university system. It should be a major objective of a National Science Policy to improve the level of scientific and technological literacy in the population.

GOVERNMENT/INDUSTRY/UNIVERSITY INTERACTION

Corporate R & D centres have some difficulty transferring technology to the manufacturing operation. Government laboratories are even less effective not only because of the physical remoteness but because of the organizational distance that isolates their activity from its applications. The likelihood of government laboratories becoming more useful to industry is remote since technology is moving in a direction that favours integrated activity. Nonetheless, efforts must be made to get the staff of government laboratories and university researchers closer to industry by having them spend periods of time working in industry.

DOCUMENT: 830-220/025

CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

Résumé de la communication intitulée:
Creating the Science Environment

Association canadienne des manufacturiers d'équipement
électrique et électronique

le 8-10 juin 1986
Winnipeg (Manitoba)

ASSOCIATION CANADIENNE DES MANUFACTURIERS
D'ÉQUIPEMENT ÉLECTRIQUE ET ÉLECTRONIQUE

RÉSUMÉ DE LA COMMUNICATION INTITULÉE:
CREATING THE SCIENCE ENVIRONMENT

INTRODUCTION

L'industrie canadienne accorde un intérêt primordial au choix et à la mise en oeuvre d'une Politique des sciences par le gouvernement fédéral. Comme dans les années passées on s'est souvent contenté de mentionner du bout des lèvres l'importance de cette question, nous estimons qu'il faudrait, en même temps qu'on annoncera cette Politique, mettre en place un mécanisme donnant la priorité aux grandes initiatives. Pour que l'ingénierie et les sciences canadiennes deviennent les moteurs de l'économie, il leur faudra avoir le soutien des autorités au plus haut niveau, et une représentation auprès d'elles.

La Politique des sciences ne devra pas s'intéresser seulement à la recherche fondamentale car, dans un futur contexte libre-échangiste, la balance commerciale de notre pays dépendra étroitement de l'orientation donnée par cette Politique à l'effort de R-D industrielle.

De plus en plus, le niveau de vie de nos compatriotes et la santé économique du Canada seront influencés par la diminution de nos ressources naturelles, mais aussi par le pouvoir concurrentiel d- nos industries de matière grise et secteurs de pointe, tant au pays qu'à l'étranger.

LA R-D INDUSTRIELLE

La branche du matériel électrique et électronique consacre à l'effort de R-D des montants plus élevés que la plupart des autres branches de l'industrie; mais il est évident que cet effort n'est pas suffisant pour assurer son dynamisme futur. En 1984, de nombreuses entreprises de cette branche ont consacré plus de 4 pour cent de leurs recettes brutes à leur effort de R-D, soit plus du triple de la moyenne nationale. D'autres entreprises de la même branche, qui connaissent un développement rapide, y consacrent plus de 5 pour cent de leurs recettes brutes, et même jusqu'à 20 pour cent.

Il n'est pas possible en fait que la branche du matériel électrique et électronique puisse consacrer, dans son ensemble, jusqu'à 5 pour cent de son chiffre d'affaires à la R-D sans obtenir un soutien substantiel de l'État, particulièrement sous forme de contrats de développement de leur potentiel technologique*. Ce genre de contrat est attrayant, car on peut lui associer une nouvelle répartition des dépenses de R-D de l'État.

Pour être efficace, la stratégie de R-D doit être globale, et compléter l'ensemble du processus de fabrication et de commercialisation. Il faut que la R-D industrielle soit axée sur le marché et qu'elle évolue constamment pour satisfaire des besoins toujours changeants, tant au pays qu'à l'étranger.

LE DÉVELOPPEMENT DES POTENTIELS TECHNOLOGIQUES

L'une des principales raisons d'un moindre soutien de l'État au développement industriel que celui qu'on observe dans d'autres pays est qu'il n'accorde pas de gros contrats aux entreprises qui ont absolument besoin de développer leur potentiel technologique. Dans certains pays industrialisés concurrents du nôtre, le soutien non fiscal atteint jusqu'à 33 pour cent du financement de la R-D industrielle, alors qu'il n'est que d'environ 12 pour cent au Canada.

Il y a là une possibilité dont notre pays ne tire pas profit. Les contrats de l'État sont en général accordés lors d'un concours serré, où rien n'est prévu pour les frais substantiels de développement du potentiel technologique. Dans d'autres pays, l'État pratique largement l'octroi de contrats tenant compte de ces frais de développement, ce qui n'attire pas l'attention comme l'attribution de subventions ou de déductions fiscales le ferait, et n'évoque pas la concurrence déloyale.

Il faut que les autorités canadiennes fassent une utilisation plus judicieuse des marchés publics pour aider au développement des industries techniques. Les contrats publics de développement technologique doivent aller à l'industrie, et non aux laboratoires de l'État.

* Enabling Technology Contracts

LES INCITATIONS FISCALES, LES MARCHÉS PUBLICS ET LES SUBVENTIONS.

Environ 16 pour cent du chiffre d'affaires de l'industrie sont réclamés par le Trésor public, sous forme de taxe fédérale de vente et d'impôt sur le revenu des sociétés, alors que l'industrie de fabrication n'en retient elle-même qu'environ 4 pour cent en moyenne. Ce partage disproportionné oblige l'industrie de fabrication à dépendre énormément de l'aide de l'État pour ses efforts de développement, particulièrement sur le plan de la recherche et de l'application des découvertes scientifiques. Les pays de l'OCDE pratiquent largement cette participation de l'État, sauf au Canada où elle n'a pas atteint un niveau similaire.

Nous estimons que cette collaboration de l'État avec l'industrie pourrait se dérouler selon cinq lignes de forces:

a) <u>Par l'octroi de contrats de développement du potentiel technologique</u>;

b) <u>Par des subventions directes</u>;

c) <u>par des incitations fiscales à la recherche et au développement technique</u>;

d) <u>par le truchement des marchés publics</u>;

e) <u>par un mécanisme d'aide aux entreprises ne réalisant pas suffisamment de bénéfices pour obtenir des dégrèvements fiscaux.</u>

En général, les incitations fiscales ne sont pas aussi avantageuses qu'elles paraissent, en raison du poids de la fiscalité. Il faut amender la Loi de l'impôt sur le revenu des sociétés pour permettre à celles-ci de tirer tous les avantages possibles de ces incitations fiscales. Les Administrations provinciales doivent renoncer aux rentrées imprévues procurées par l'imposition des incitations fédérales à la R-D ou, à leur place, procurer des avantages

équivalents aux réalisateurs industriels de R-D de leur province.

LES CAPITAUX D'INVESTISSEMENT

L'industrie aura besoin de recueillir d'importants capitaux au sein des sociétés ou auprès des particuliers pour se développer suffisamment au cours de la prochaine décennie. Pour les petites entreprises en croissance rapide, il s'agit là d'un problème épineux. La création, par les autorités publiques, d'un plan national d'investissement des particuliers dans des valeurs industrielles, semblable à celui mis en oeuvre au Québec, et complété par un barème décroissant de dégrèvements fiscaux pour les investisseurs, permettrait de le résoudre.

LE PERFECTIONNEMENT DES SPÉCIALISTES

Il faut que les entreprises industrielles et les universités concluent une alliance nouvelle, fondée sur l'acquisition d'une expérience industrielle par le corps enseignant et un séjour universitaire pour les cadres industriels, et aussi sur un accent nouveau donné par les universités à l'enseignement des matières fondamentales.

Bien qu'un financement supplémentaire de l'enseignement puisse être utile, il ne suffirait pas à résoudre l'ensemble des problèmes. Actuellement, le Canada consacre une part suffisante de son Produit intérieur brut à l'enseignement. Ses grands concurrents industrialisés lui accordent une partie plus faible de la richesse nationale. C'est plutôt la répartition de ces sommes au sein du système d'enseignement qu'il faut modifier, et la capacité d'adaptation de ce dernier aux conditions nouvelles qu'il faut accroître.

Nous estimons que cette réforme de l'enseignement doit être entreprise par le biais d'une planification stratégique, et qu'on doit adopter un plan de formation technique et de perfectionnement des spécialistes, bien articulé avec la Politique nationale des sciences. La planification stratégique doit porter

sur des thèmes tels que le renouvellement du corps professoral, les investissements en capital, les disciplines porteuses d'avenir comme l'ingénierie et l'informatique, un mécanisme réaliste de financement des universités et des méthodes permettant d' accroître l'adaptabilité des structures.

Nous estimons aussi qu'il existe un certain degré d'ignorance technique parmi le public, qui tire son origine de l'enseignement secondaire, et qui est propagé par l'enseignement universitaire. La Politique nationale des sciences devrait avoir, parmi ses objectifs principaux, celui d'améliorer le niveau de culture scientifique et technologique de la population.

LES INTERACTIONS ENTRE LES SECTEURS PUBLIC, INDUSTRIEL ET UNIVERSITAIRE

Les laboratoires de R-D de l'industrie ressentent quelques difficultés quand ils s'efforcent de communiquer les techniques nouvelles aux divisions de fabrication. Les laboratoires de l'État sont encore moins efficaces, non seulement en raison de leur éloignement, mais aussi à cause du cloisonnement entre leurs activités de recherche et l'application de ses résultats. Il est peu probable qu'ils puissent être plus utiles à l'industrie, car le progrès technologique va vers l'intégration des activités industrielles. Cependant, il faut s'efforcer de rapprocher les chercheurs de l'État et ceux des universités des réalités industrielles en leur faisant accomplir des stages de travail dans l'industrie.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

A Brief Reflection on
"Building on Our Strengths"

Fraser Institute

June 8-10, 1986
Winnipeg, Manitoba

A BRIEF REFLECTION ON
"Building on Our Strengths"

Kristian Palda, Queen's University
and Fraser Institute*

June 9, 1986

INTRODUCTION

The MOSST background paper "Building on Our Strengths", and, indeed, the whole theme of the Canadian Forum on a National Science and Technology Policy (Winnipeg, June 8-10) builds on two fundamental premises. The first is that Canada's scientific and technological-innovative performance is unsatisfactory and the second, reposing on the first, is that a national, government-launched policy can remedy the sorry situation. Thus the Forum is invoked to discuss "the parameters" of a national science and technology policy.

Here it will be argued that both premises are patently false. There is therefore no need for yet another attempt at industrial policy -- parading in technology clothing -- and especially not by a conservative federal government committed to reducing rather than increasing the tax burden of Canadians.

UNIVERSITY AND INDUSTRIAL SECTOR PERFORMANCE IN SCIENCE AND TECHNOLGY

a) University Performance

Among a number of questions that this Forum is to debate, one stands out for its thorough imprecision:

> Is Canada getting maximum beneits for money spent on university research? If not, what...

What is the meaning of <u>benefits</u> flowing from university research? Is it the number of refereed articles per research dollar, or the number of citations, or the number of patents, or the number of technical innovations launched, or the sales or savings therefrom per dollar spent? Will analytical diversity weigh less in the appraisal than

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*The views expressed here may not conform singly or collectively with those of the members of the Institute; Queen's has no official position on these issues.

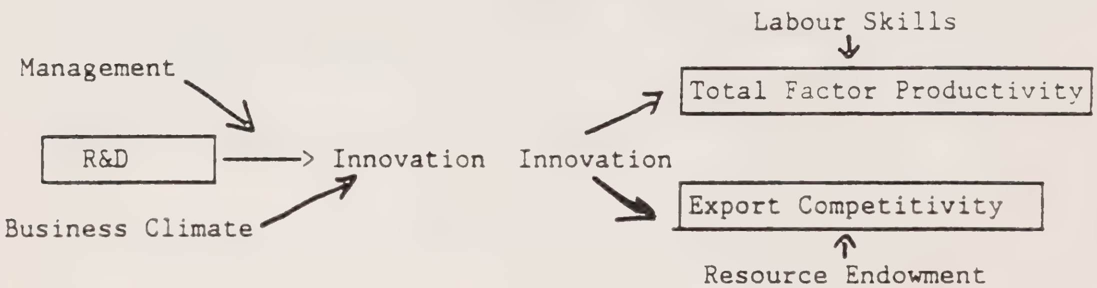
microbiology ? Who is bold enough to make these measurements and pronounce performance unsatisfactory? NSERC, NRC, the Science Council, MOSST or the Canadian Manufacturer's Association?

b) Industrial Performance

The definition of benefits from industrial innovation is conceptually easier than in the case of university research. It is the enhancement of revenues or decrease in costs of the firm or the industry. Yet the difficulty of estimating the net impact of technological innovation upon return on investment leads many observers and most governments to rely on substitute measures of performance, on "input" or "output" measures of innovation. As Figure 1 makes it clear, R&D is but one of several influences on the realization of a successful innovation; similarly, more than just innovation is responsible for trade advantage or productivity improvement.

Figure 1 (1)

"Input" and "Output" Sides of Innovation



Even these proxy measures of technical-innovative performance are, however, constructed and used in too simplistic a manner:

<u>R&D intensity</u>: measured on the <u>economy-wide level</u> as GERD/GNP(2) and then compared to other OECD partners (Canada, 1984, 1.35%, Austria 1.23, France 2.15, UK 2.27) totally disregards the sectoral structure of these economies as well as of the defence burdens carried by them(3).

: measured on the <u>industry level</u> as R&D/Output disregards suppliers' R&D embodied in imported inputs, government and university research undertaken on behalf of the industry and, above all, the massive (on the order of $1 billion) <u>invisible</u>, i.e. unpaid for, importation of R&D results from multinational affiliates(4).

<u>Trade Competivity</u>: given the misleading measures of research intensity used in the definition of technologically-intensive

industries, the consistently excellent trade performance of resource-oriented industries is falsely attributed to nature's endowment rather than to the massive infusion of publicly funded research.

: world trade shares of Canadian exports naturally decline as trade widens explosively, while sales expand; trade deficits, to be properly compared over time, must be deflated with constant dollars or "normalized"(5).

When these two proxy measures of innovative performance are properly estimated, Canada and its industrial sectors place in no way below OECD standards.

GOVERNMENT PERFORMANCE IN SUPPORT OF INNOVATION

a) Actual support of innovative thrust by government financing --

as measured by percentage of GERD financed from public sources (Canada, 1984, 54.5%, Austria, 1981, 43.8%, France, 1984, 54.4%, UK, 1983, 50.2%)

as measured by percentage of BERD financed by government (Canada, 1983, 11.2%, Austria, 1981, 7.4%, France, 1983, 22.4%, UK, 1983, 30.2%, Sweden, 1983, 10.4%) --

documented by OECD statistical comparisons seems perfectly adequate. Direct assistance to large-scale non-performers (AECL, CCI, Challenger-Canadair) and $2 billion plus in Scientific Research Tax Credits appears overly generous.

b) Tax structure and responsiveness of industry.

McFetridge and Warda, writing before SRTC, offered persuasive evidence that Canada is the most generous of 11 comparable countries in offering fiscal and grant stimulus to private sector R&D(6). If Canadian industry's R&D spending is nevertheless officially considered inadequate, the blame must lie in the sluggishness of response toward the incentives offered to industry. Studies by Bernstein(7) and Mansfield & Switzer(8) do indicate that the elasticity of response to fiscal and subsidy incentives is quite low. A definitive judgement must await the economic post-mortem of one of the most expensive governmental blunders in Canada's history, the Lalonde-initiated scientific research tax credits. This was a natural experiment on the order of $2 billion whose outcome will indicate, by 1989, how much of that outlay found its way into legitimate industrial research.

A NATIONAL TECHNOLOGY POLICY - YET AGAIN?

Given that private sector innovative performance cannot be shown to be inadequate on grounds of international comparison and given that taxpayer support of industrial innovation was, if anything, on the side of generosity there appear few grounds for a tax-supported mobilization of Canada's technological resources.

It may be that elective officials have no history-related memories, but participants in this Forum come also from the ranks of the public service, industry and universities and they will remember an Ottawa conference called Canada Tomorrow, staged within living memory, and opened by the then prime minister. They will also recall the 1981 MacEachen budget paper Economic Development for Canada, the 1982 Don Johnston express refutation of it and declaration of a new policy destined to make Canada "a major player in the technolgical revolution that is sweeping the world", and the 1983 Lumley utter retreat from industrial policy making (1, pp. 5-6). Finally, they will also remember the estates-general of French science called in 1982 by the freshly installed socialist government of France, the sweeping new science and technology policies announced in that country and approvingly referred to by Ed Broadbent, the generous budgets allotted, and the retreat from all this glory by 1984 in the face of economic reality.

Should we not admit into our planning lessons from history?

DOCUMENT: 830-220/026

CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

Brève réflexion sur "Les moyens de notre avenir"

Institut Fraser

le 8-10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

BRÈVE RÉFLEXION SUR
"Les moyens de notre avenir"

Le 9 juin 1986

M. Kirstian Palda, Université Queen's et Institut Fraser*

INTRODUCTION

Le document de travail du MEST intitulé "Les moyens de notre avenir" et, en fait, le concept même de la Conférence nationale sur la politique scientifique et technologique (du 8 au 10 juin, à Winnipeg) reposent sur deux prémisses fondamentales. La première est que le rendement du Canada dans l'innovation scientifique et technologique est insuffisant et la seconde, découlant de la première, est qu'une politique nationale lancée par le gouvernement peut remédier à cette triste situation. Par conséquent, la conférence vise à discuter des paramètres d'une politique nationale des sciences et de la technologie.

Nous allons tenter de démontrer ici que ces prémisses ne reposent sur rien de concret et qu'il n'y a donc aucune nécessité de tenter une fois de plus d'implanter une politique industrielle, recouverte d'un vernis technologique, surtout pas venant d'un gouvernement fédéral conservateur qui s'est engagé à réduire le fardeau fiscal des Canadiens, et non à l'accroître.

RENDEMENT DES UNIVERSITÉS ET DE L'INDUSTRIE EN SCIENCES ET TECHNOLOGIE

a) Rendement des universités

Parmi les questions qui seront débattues à la Conférence, l'une d'entre elles se distingue par son imprécision flagrante :

> Le Canada retire-t-il un maximum d'avantages des fonds consacrés à la recherche universitaire? Dans la négative, quelles mesures pourrait-on prendre?

Que veut-on dire exactement en parlant des avantages découlant de la recherche universitaire? S'agit-il du nombre d'articles publiés cités en référence par dollar de recherche, du nombre de citations, du nombre de brevets, du nombre d'innovations techniques mises en application ou des ventes ou économies réalisées

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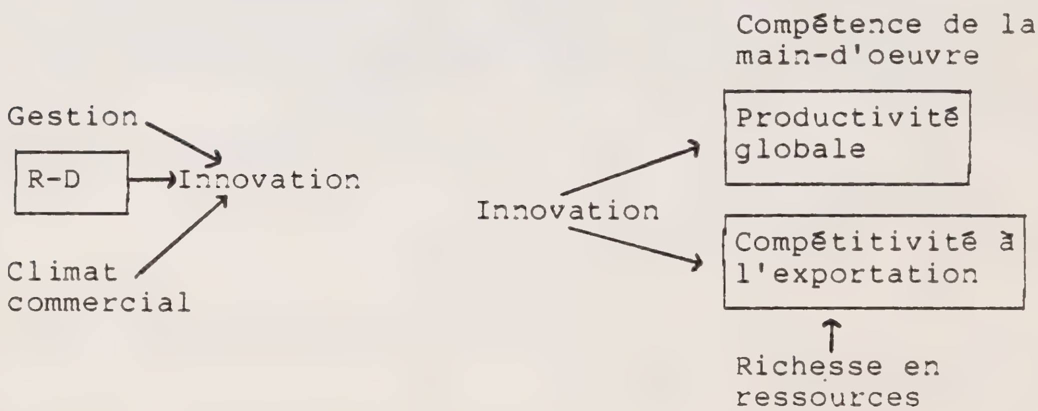
* Les opinions exprimées ici ne sont pas nécessairement celles de Institut Fraser ou de ses membres; l'Université Queen's n'a pas exprimé d'opinion officielle sur le sujet.

par dollar investi en recherche? La diversité analytique est-elle aussi valable que la microbiologie? Qui aura l'audace de quantifier de tels facteurs et de déclarer que le rendement est satisfaisant ou non? Le CRSNG, le Conseil des sciences, le MEST ou l'Association canadienne des manufacturiers?

b) Rendement de l'industrie

Le concept d'avantages dérivés de l'innovation industrielle est plus facile à définir que dans le cas de la recherche universitaire. Néanmoins, la difficulté d'estimer l'impact exact de l'innovation technologique sur le rendement de l'investissement mène plusieurs observateurs et la plupart des gouvernements à se fier à d'autres mesures du rendement, à mesurer l'innovation en termes d'intrants et d'extrants. Comme la figure 1 l'indique clairement, la R-D n'est que l'un des nombreux facteurs qui influencent le succès d'une innovation; parallèlement, il n'y a pas que l'innovation qui procure des avantages commerciaux ou qui stimule la productivité.

Figure 1(1)
Intrants et extrants de l'innovation



Même ces mesures indirectes du rendement de l'innovation technique sont conçues et utilisées de façon trop simpliste :

Intensité de la R-D : la mesure à l'échelle de toute l'économie, en DBRD/PIB (2) et comparativement aux autres membres de l'OCDE (en 1984 au Canada, 1,35 %, en Autriche, 1,23 %, en France, 2,15 %, au R.-U., 2,27 %) ne tient aucun compte de la structure sectorielle de ces économies et de leur fardeau de défense respectif (3).

: La mesure à <u>l'échelle industrielle</u>, en R-D/extrants, ne tient aucun compte de la R-D des intrants, de la recherche universitaire et gouvernementale entreprise pour l'industrie et encore plus, de l'importation massive (de l'ordre de 1 milliard $) et <u>invisible</u> des résultats de la R-D de filiales de multinationales (4).

<u>Compétitivité à l'exportation</u> : à cause des critères trompeurs de mesure de l'intensité de la recherche dans les industries axées sur la technologie. L'excellent rendement constant à l'exportation des industries axées sur les ressources est attribué à tort à l'abondance de ces ressources plutôt qu'à l'utilisation massive du résultat de recherches à financement public.

: La part canadienne du commerce mondial baisse naturellement à mesure que s'accroît le volume mondial des échanges, mais les ventes augmentent; pour comparer les déficits commerciaux d'une année à l'autre, il faut les exprimer en dollars constants ou "normalisés"(5).

<u>En utilisant de façon appropriée ces deux mesures indirectes du rendement de l'innovation, le Canada et son industrie ne font plus figure de parents pauvres de l'OCDE</u>.

RENDEMENT DU GOUVERNEMENT DANS LE SOUTIEN DE L'INNOVATION

a) Appui réel à l'innovation par un financement gouvernemental :

mesuré en pourcentage des <u>DBRD</u> financées par les fonds publics (en 1984 au Canada, 54,5 %, en 1981 en Autriche, 43,8 %, en 1984 en France, 54,4 %, en 1983 au R.-U., 50,2 %);

mesuré en pourcentage des <u>DIRD</u> financées par le gouvernement (en 1983 au Canada, 11,2 %, en 1981 en Autriche, 7,4 %, en 1983 en France, 22,4 %, en 1983 au R.-U., 30,2 %, en 1983 en Suède, 10,4 %).

Notre rendement semble parfaitement adéquat dans cette comparaison statistique avec d'autres membres de l'OCDE. L'aide directe à grande échelle à des sociétés qui n'ont pas obtenu de résultats satisfaisants (EACL, CCI, Challenger-Canadair) et les 2 milliards $ du crédit d'impôt à la recherche scientifique (CIRS) semblent un excès de générosité.

b) Structure fiscale et réactions de l'industrie

McFetridge et Warda, <u>avant</u> l'introduction du CIRS, avançaient des arguments convaincants à l'effet que le Canada était le plus généreux de 11 pays comparables offrant des stimulants fiscaux et des subventions à la R-D du secteur privé(6). Si l'on estime néanmoins officiellement que les dépenses de l'industrie canadienne en R-D sont inadéquates, il faut en blâmer la lenteur de l'industrie à réagir aux stimulants. Des études de Bernstein(7) et Mansfield et Switzer(8) indiquent effectivement que l'élasticité de la réaction aux stimulants fiscaux et aux subventions est plutôt faible. Les prochaines années permettront de porter un jugement économique définitif sur l'une des gaffes gouvernementales les plus coûteuses de l'histoire canadienne, le crédit d'impôt à la recherche scientifique de Lalonde. Il s'agissait d'une expérience sauvage de l'ordre de 2 milliards $ et c'est en 1989 que nous saurons quelle proportion de ce total est allée à la recherche industrielle véritable.

UNE POLITIQUE NATIONALE DE LA TECHNOLOGIE - ENCORE?

Si l'on convient que le rendement du secteur privé dans l'innovation se compare à celui des autres pays et que l'appui du contribuable à l'innovation industrielle se situe plutôt du côté de la générosité, il semble rester peu d'arguments en faveur d'une mobilisation à même les deniers publics des ressources technologiques du Canada.

Nos élus ont peut-être une mémoire historique déficiente, mais les participants à cette conférence proviennent eux aussi de la fonction publique, de l'industrie et des milieux universitaires et ils se souviendront d'une conférence intitulée "Le Canada demain", qui ne remonte pas à si longtemps, inaugurée par le Premier ministre de l'époque. Ils se souviendront également du document budgétaire déposé en 1981 par M. MacEachen, <u>Le développement économique du Canada dans les années 80</u>, et sa réfutation sans équivoque par Don Johnston en 1982 avec l'annonce d'une nouvelle politique qui ferait du Canada un acteur de premier plan dans la révolution technologique qui balaie le monde, le tout suivi de la retraite complète par rapport à la

formulation d'une politique industrielle par Lumley en 1983 (1, pp. 5-6). Finalement, on se souviendra aussi du Colloque national sur la recherche et la technologie, convoqué en France en 1982 par le gouvernement socialiste qui arrivait au pouvoir, où l'on annonçait de nouvelles grandes politiques globales des sciences et de la technologie, citées en exemple par Ed Broadbent, des généreux budgets prévus, et de la volte-face de 1984 lorsque la réalité économique s'est imposée.

Ne devrions-nous pas tirer leçon de l'histoire dans notre planification économique?

DOCUMENT: 830-220/027

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

How to Create Industries of Comparative Advantage

Institute of Electrical and Electronic Engineers

June 8-10, 1986
Winnipeg, Manitoba

GS-0586/35

May 27, 1986

Hon. Frank Oberle
Minister of State for Science
and Technology
Ottawa
Ontario
K1A 1A1

Dear Mr. Oberle,

Mr. Fred J. Heath, Regional Manager, IEEE, has asked me to represent him at the Canadian Forum on a National Science and Technology Policy. I am pleased to accept.

I am enclosing a paper entitled "How to create industries of comparative advantage". This paper does not directly address the specific questions you proposed, because I do not accept some of the assumptions on which they are based. I believe you will agree however, that my paper does address the real concerns of those interested in the subject of the Forum.

Yours truly,

George Sinclair
Past Regional Director
I.E.E.E.

cc: Mr. Fred J. Heath

HOW TO CREATE INDUSTRIES OF COMPARATIVE ADVANTAGE

George Sinclair
Past Canadian Regional Director
Institute of Electrical and Electronic Engineers

May 25, 1986

Sinclair Radio Laboratories Limited
85 Mary Street
Aurora, Ontario
L4G 3G9

Executive Summary

It is argued that science and technology policies represent the wrong solution for the wrong problem. The lack of industrial R&D in Canada is merely a symptom of the fact that we lack the innovative companies required to exploit the results of R&D. Our major problem is shown to be our failure to generate satisfactory rates of economic growth.

Canada's huge budget deficit is claimed to result from our low rate of economic growth. It is argued that we must increase our Gross Domestic Product by at least $90 billion, and this cannot possibly be accomplished by any conceivable science or technology policies. Free trade will not do it either.

As an example of the obstacles and frustrations hampering the creation of companies capable of generating economic growth, the author describes his career spanning 50 years devoted to creating "industries of comparative advantage". These operations are described, each being a world leader.

It is known in the economic community that modern economic theories are useless for solving the economic problems of modern society, but recommendations for improving them are not available. It is argued that, following the example of Japan, we need a new discipline called economic systems engineering.

How To Create Industries of Comparative Advantage

by George Sinclair

Introduction

One of the major assumptions underlying theories of free trade is the expectation that each nation will develop its own "industries of comparative advantage". Both Canada and the United States have conspicuously failed to do this, especially in comparison with Japan, to the point where our economic advisers no longer even discuss the problem. We lack the competence to develop such industries.

All of our current industrial assistance programs are geared to creating innovative companies to produce ingenious products and services. They are of very limited use for generating innovative industries. The author has had a 50-year career as a professional engineer attempting to create innovative industries, with some success. As a general rule, it would be fair to claim that the industries were created in spite of Canada's industrial policies.

The following material is the result of the author's experience. The successes are:

Sinclair Radio Laboratories Limited, Aurora, Ontario.

1. SRL has been the major supplier for 35 years, of communication antennas designed to operate in an arctic environment. Our competitors only promise that their antennas will survive, but not necessarily operate.
2. SRL for the past 30 years has been the world leader in the field of military multicouplers for naval warships. SRL multicouplers used by the Royal Navy performed perfectly in the recent Falklands War.

3. SRL created a new industry, namely production of commercial multicouplers which permit several customers to use a common antenna for their two-way radio systems. SRL has been the world leader for 25 years.

Almax Industries (1980) Limited, Lindsay, Ontario.

Almax is currently rated as one of the world leaders in the new field of industrial ceramics, which Japan has chosen to be its next major growth industry. The successes are:

1. Almax absolutely dominates the North American market for very large PZT ceramic components used to generate and detect ultrasonic signals in military sonobuoys, sonars, etc.
2. Almax is the only supplier of a ceramic called sodium potassium niobate used for signal processing in modern radars.
3. Almax has just announced it is life-testing a new passive thermoelectric generator for converting heat energy to electric energy. With an efficiency of 20%, it is causing excitement in the solar energy field. According to competitors in the United States, Almax has a five-year lead over American companies. The heart of the device is a new ceramic called beta alumina. Almax produces a product which is superior to what our competitors can produce.
4. Almax has acquired the exclusive North American licence to some French patents for a new concept in electric kilns capable of attaining very high temperatures (2200^{o}C). A laboratory kiln is now being sold.
5. A new facility to produce alumina ceramic products for Canada's hard-rock mining industry is planned. It will be the first in Canada. A new ceramic called zirconia-toughened alumina will be produced in the near future.

A conspicuous failure was a project to make SRL the world's leading manufacturer of modern aircraft antennas. SRL was developing most of the antennas for the ill-fated Avro Arrow fighter. At the time, SRL had a five-year lead over U.S organizations. Sinclair had pioneered the scale model techniques now used universally for designing antennas to be used on aircraft, missiles and spacecraft.

In the following, it is contended that our economic problems stem from the fact that macroeconomics on which our economic policies are based, is mostly mythology insofar as they relate to economic, industrial and trade policies.

Macroeconomics - A Modern Mythology

In Jane Jacobs' recent book[1], the first chapter carries the title "Fool's Paradise" and it concludes with the statement that we would be rash to suppose that macroeconomic theories will ever solve our economic problems. She is not the first writer to echo these sentiments, as many prominent U.S economists have published similar statements.

Canada's favourite economist, John Kenneth Galbraith[2] of Harvard used the following theme for his Presidential Address to the American Economics Association:

> "Neoclassical or neo-Keynesian economics, though providing unlimited opportunity for demanding refinement, has a decisive flaw. It offers no useful handle for grasping the economic problems that now beset the modern society. And these problems are obtrusive - they will not lie down and die as a favour to our profession.... The decisive weakness in neoclassical and neo-Keynesian economics is not the error in the assumptions by which it elides the problem of power. The capacity for erroneous belief is very great, especially where it coincides with convenience. Rather in eliding power - making economics a nonpolitical subject - neoclassical theory, by the same process, destroys its relation with the real world.... In consequence, neoclassical and neo-Keynesian economics is relegating its players to the social sidelines where they either call no plays or uge the wrong ones."

Wasily Leontieff[3], a Nobel prize-winner in economics at New York University has noted thhe intellectual bankruptcy of the economics community. He pointed out that:

> "Year after year economic theorists continue to produce scores of mathematical models and to explore in great detail their formal properties; and the econometricians fit algebraic functions of all possible shapes to essentially the same sets of data without being able to advance, in any perceptible way, a systematic understanding of the structure and the operations of a real economic system".

Many other economists would agree that modern economic theories, whether macroeconomic or microeconomic, are useless for dealing with the urgent economic problems of modern society.[4,5,6]

It is clear that our economic policymakers have an obligation to explain why governments should accept their recommendations, especially in the field of macroeconomics. Lester Thurow[5], the well-known M.I.T. economist, recently noted that Japan has <u>no macroeconomic policies</u>! Canada and the United States have <u>only</u> macroeconomic policies. The economists owe us an explanation.

Surely there is no justification whatsoever for promoting such macroeconomic policies as:

free trade policies
protectionist policies
science policy
technology policy
deficit reduction

Such policies must be regarded as modern mythology.

<u>Science and Technology Policies</u>

The concepts of science and technology policies are widely accepted in academic communities as being important for producing economic growth. Surely the facts refute this claim. For instance, in the United States,

the total national expenditures on research and development in the last 25 years have exceeded the staggering sum of $0.6 trillion, yet the benefits are hard to prove. The R&D expenditures have failed to produce the expected impacts on the U.S economy. We should note:

1. the loss of position as world leader in industrial development
2. very little industrial innovation of significant economic importance
3. federal budget deficits of the order of $200 billion per year
4. rates of economic growth averaging 2 percent in recent years[11]
5. large international trade deficits. For 1986 the deficit is expected to reach $150 billion
6. chronic unemployment of around 7 million unemployed
7. the number of people living below the poverty line is now the largest in history.

One has to ask why does Canada need to discuss national science and technology policies?

The academics have never discovered that industrial innovations are created by people, and not by some mysterious 'science', or technology'. According to Peter Drucker[7], the eminent U.S management consultant,

> "Industrial innovations do not begin with an R&D budget, They end with one. Innovations are created by people."

This author has demonstrated the validity of this statement many times.

The academic community is quite unaware that the concept of 'technology' is strictly a twentieth century mythology. The problem with the concept is that it is impossible to give it a meaningful definition. Langdon Winner of M.I.T began a review of a book on philosophy and technology[8], as follows:

> "Perhaps the only accurate observation one can make about the philosophy of technology is that there really isn't one!"

In other words, there is no concensus as to what constitutes technology.

Another philosopher, Borgmann[9], has stated that the problem is not just a matter of semantics, but a question of what concepts are involved. The difficulty with the term is that any concept as complex as technology, science, engineering, profession, history, etc, cannot be defined in a single sentence. A whole volume is required.

For example, if one desires to comprehend the meaning of the term 'science', it is necessary to consult a volume on the philosophy of science. The philosophy of science deals with such questions as: why does society need scientists? how do their activities produce an impact on society? etc.

There does not exist a useful philosophy of technology. As Winner[8] indicates, a philosophy of technology cannot result from abstract speculation. He claims that dialogue with engineers is essential. Unfortunately there are no engineers capable of engaging in meaningful discussions because there does not exist a philosophy of engineering. Without such a philosophy, technology will remain in the realm of mythology.

The recent report from the National Research Council entitled "A Practical Perspective"[10] outlines a five-year plan for increasing industrial research and development in Canadian industry, but it is based on myth and fallacy. If the stated goals are to be achieved, it is obvious that engineers must be deeply involved, yet the word 'engineer' is conspicuous by its absence. The word 'engineering' appears only incidentally in a footnote.

The failure of the NRC document to deal with the human involvement in developing Canadian industry is incomprehensible. For example, the NRC industrial assistance programs (IRAP, PILP, PRAI) are specifically designed to support only the people engaged in research and development. They pay

the salaries and wages of the personnel doing the R&D. They do not pay for such mysterious or abstract things like "science", "technology", "diffusion of technology", etc.

The claims that Canada needs national science and technology policies has not been proven. Science and technology, however defined, have nothing to do with creating industrial innovations. Canada's poor performance in the field of industrial R&D is merely a symptom, and not the cause, of our lack of industrial R&D. What we lack is an industrial environment that encourages the formation of innovative companies capable of exploiting the results of R&D. Our present policies for industrial growth are totally inadequate.

The claim that technology functions without human intervention is false. The human involvement in creating innovative companies is not merely peripheral, it is absolutely crucial. The "diffusion of technology" concept in the NRC five-year plan is quite meaningless. What the author probably meant by "diffusion of technology" is economic growth. As pointed out by Irving Kristol[4] of New York University, economic growth is a phenomenon lying in the field of microeconomics (which is why our macroeconomic policies have failed to generate it). Economic growth occurs when people have the freedom, and the motivation, to improve their own economic condition by creating companies capable of generating wealth from the manufacture and sale of products which can be sold.[4] This rarely happens today.

The belief that there is a shortage of ideas for developing innovations is pure myth. Some years ago I examined the annual report on NRC research grants given to departments of electrical engineering in Canadian universities. I was looking for ideas having a potential for innovation and I found 43 of them. Sinclair Radio could have converted most of them into industrial innovations. This did not happen, however, mainly because

the costs would be too large compared to the possible rewards.

Free Trade and Protectionism

Free trade and protectionism are also in the category of mythology. The economists have chosen to ignore the fundamental assumptions on which the original free trade theories were based. Of greatest importance is the assumption that, in order to maximize the benefits of free trade, it is necessary for each nation to develop its own "industries of comparative advantage". Neither Canada nor the United States have managed to do this in recent history.

Another assumption which was not explicitly stated, was that production costs would be approximately equal in each nation. The assumption may have been true at one time, but it is definitely not true today. For example, consider the impact of taxation on production costs.

As Lee Iacocca of the Chrysler Corporation has pointed out, there is a very large discrepancy in the taxes paid on automobiles in Japan as compared to the United States. One study has shown that the Japanese can produce a certain model of automobile for $1,500 less than the cost in Detroit, mostly attributable to differences in taxation.

An estimate of the impact of taxation on production can be made. According to OECD data, for 1984 the total tax revenues collected by all government agencies in Canada amounted to 39.6 percent of our Gross Domestic Product. The corresponding figures are 31.7 percent for the United States and 29.9 percent for Japan. See Table I.

Since I am lacking any better data, I assume that, on average, that these percentages when applied to the wholesale price of domestic goods provide a rough estimate of the tax component of the price. However, as pointed out by Mr. Iacocca, Japanese industries do receive tax concessions which provide Japanese exporters with an added advantage on taxes.

In the forthcoming free trade negotiations between Canada and the United States, the matter of subsidization of domestic production will be discussed. I wonder if the enormous advantage provided by U.S defence contracts to U.S industry in developing new commercial products will be on the table. Canada currently faces trade deficits in so-called "high-tech" products of the order of $12.5 billion per year. The importance of defence contracts subsidizing the development of high-tech commecial products is hard to assess but surely is important. In addition, the influence of the large industrial lobbies in Washington should also be considered as an important non-tariff trade barrier.

Another free trade myth is the assumption that all goods in international trade are of equal economic significance. This is not true. There are at least four categories which merit separate consideration:

1. Primary products involving non-renewable natural resources.
2. Primary products involving renewable resources
3. Manufactured goods
4. Services

Industries in the first two categories can only supply their markets by means of exports from Canada. Exports in these industries have important political aspects and I will make no further comments.

Exports of manufactured goods need separate consideration. In particular, exporting from Canada is only one way of serving an international market. There are several Canadian companies which are capable of competing in the

U.S market. Almost all of them have U.S subsidiaries which make them immune to trade barriers.

Sinclair Radio has had a wholly-owned subsidiary in Tonawanda, NY, since 1960. As a result SRL has had free and complete access to its U.S market irrespective of any tariff barriers. Also, Almax Industries which exports 90 percent of its products to U.S defence contractors, already operates in a free trade environment, since defence equipment is duty-free. It is a myth that the removal of tariff barriers between the U.S and Canada will provide a major benefit for Canadian manufacturers. What Canadian industry needs is an environment in which they can become large enough to be able to compete.

However, what really makes free trade policies pure mythology is the claims of macroeconomists that Canada's economic goal is the complete removal of all trade barriers worldwide. Prime Minister Trudeau, for many years, emphasized this goal at the annual Economic Summit Conferences of the seven national leaders.

Free trade is not even a legitimate choice for an economic goal. Free trade is actually an economic principle and if the principle proves to be invalid, Canada surely faces economic disaster. I would claim that a valid choice of a goal in any field should satisfy two criteria:

1. the goal must be reasonably attainable,
2. progress to the goal must be measurable.

Free trade does not qualify. The proliferation of new protectionist measures in most nations shows that the goal is not attainable. Progress in removing tariff and trade barriers is impossible to quantify.

A little reflection reveals that the real goal of the free trade economists is the stimulation of economic growth. Our economic goal clearly should be to attain higher rates of economic growth. Policies for achieving this are

surely possible, as Japan has demonstrated. Japan has for many years had an annual target of economic growth equal to at least 6 percent of its GNP. It has failed to reach this goal in recent years. See Table I.

Attaining a Goal of Greater Economic Growth

The world leader in achieving high rates of economic growth is clearly Japan. It is therefore of critical importance to understand how this has been accomplished. As Thurow[5] has pointed out, Japan has no macroeconomic policies.

On this continent, economists recognize two main categories of economic theories:

1. macroeconomics - the study of aggregates of economic variables in a given geographic region.
2. microeconomics - the study of economic variables in an individual business or industrial enterprise.

While the Japanese government does have many microeconomic policies, it would be incorrect to assume this to be the secret of Japan's economic success.

A key concept in Japanese industrial policy was stated early in the period following World War II when Japan was struggling to rebuild its industries. This concept was public knowledge:

> "Japan's domestic companies shall face no competition in their domestic market from either imports or foreign subsidiaries, at least until they become internationally competitive."

Japanese companies have become very successful in international markets, but this policy has never been rescinded. It proved to be so successful that it would be unwise to terminate it. The Japanese government has refused to open its domestic market to unrestricted imports. The reason is very simple, namely, imports are so costly to their economy that they cannot afford them. Our economists on the other hand, claim that our domestic products are so expensive that our consumers cannot afford them.

Someone is making an error and I doubt it is the Japanese.

Actually the Japanese refusal to import consumer goods is not a macroeconomic policy but a positive policy to <u>encourage</u> domestic production. Protectionism on this continent is a <u>negative</u> policy to restrict imports without any measures to create the domestic industry needed to provide domestic products.

Japan's economic policies are based on new economic theories which treat industry as a large and complex <u>system</u>. A systems approach to economic policies must deal with economic impacts on <u>all phases</u> of Japanese society.

Economic policies in Canada and the United States do not contemplate a systems involvement. What this means is that one group of economists deals with free trade, another with science and technology policies, others with budget deficits, import policies, export policies, tax policies, etc, etc, all carried out independently of each other. It is assumed, erroneously, that each policy has no interaction with the others.

For example, the forthcoming Canadian Forum on National Science and Technology Policies will focus on industrial innovation as an economic phenomenon. The discussion will ignore the major impact of free trade, of government procurement, of foreign ownership policies, etc, on industrial growth. It will be assumed that if only the proper science and technology policies can be developed, industrial innovations will occur automatically. This is more mythology.

It is useless to develop new science and technology policies without simultaneously creating the new companies capable of exploiting the results of the R&D. The creation of new companies is a problem in microeconomics but it is also very much a systems problem, namely, the creation of a proper economic environment. For example, our present industrial policies expect new industrial ventures to be internationally competitive with imports and foreign subsidiaries from the day they are launched. This ignores the fact that new ventures typically face a start-up period averaging about eight years of losses.[12] It takes a superior brand of management to bring an entrepreneurial venture through the start-up period. It is quite unfair for economists to claim that the management of our domestic companies is inept.

It is of vital importance to assess the extent of our problem in generating economic growth. Consider the matter of government budget deficits. In 1985 the Canadian deficit was about $35 billion. Our economic advisers gave us two choices:

1. increase taxes
2. reduce government expenditures.

What they failed to tell us was that there is another choice:

3. increase our GDP in order to generate new sources of taxes.

Surely it makes sense to increase the sources of taxation so we can afford our expensive social programs.

It is easy to calculate how much increase in GDP is required. According to Table I, our total government revenues for 1985 represented 39.6 percent of our GDP. This means that an increase in GDP of about $90 billion would provide the new taxes needed to eliminate the deficit.

By taking a systems viewpoint, there is another approach. Canada has about 1,250,000 unemployed at present. Suppose that, by some miracle, our economic advisers were able to devise new policies to put them to work in our existing economy. According to OECD data[11], each employed worker in Canada in 1984 contributed, on the average, $41,000 to our GDP. Thus with full employment we could expect these workers to generate about $51 billion of new GDP.

This falls short of our goal of $90 billion, and the reason is easy to find. We have the wrong mix of industries. We are becoming a nation of hewers of wood and drawers of water. For example, we have an annual deficit of $12.5 billion in the import and export of so-called "high-technology" products.

Now according to data in the Canada Year Book[9], our manufacturing industries contribute about $110,000 to our GDP per worker. It is a simple calculation to show that for the increased GDP to equal $90 billion, it will be necessary to generate $62 billion of it in increased manufacturing, over and above the GDP represented by our present mix of industries.

The above refutes the claims of economists that the service industries can be substituted for manufacturing. We have a desperate need for new manufacturing, and, in fact, almost all of the $90 billion in new GDP required will have to be from new manufacturing.

As shown by OECD (Table III) among the seven major OECD nations, Canada has the highest percentage employment in the service industries. We have a desperate need to increase the contribution of manufacturing industries to our GDP. The ideas that either free trade with the United States or better science and technology policies, will solve our economic problems is pure wishful thinking. We need to develop more manufacturing in so-called low-technology products. If innovation occurs that is merely a small extra

benefit.

Conclusions

There is no mystery at all about the creation of economic growth. Any activity which adds to our Gross Domestic Product deserves full support, while any activity which reduces the GDP should be discouraged. Thus free trade policies must be replaced with import policies which regulate imports by quotas, tariffs, etc, in accordance with their impact on our GDP. Simultaneously, measures must be in place that ensure there will exist domestic products of adequate quality. The facts that imports may be of higher quality or lower price are irrelevant.

If we need about $90 billion in new GDP, it is clear that we should ignore the entrepreneurs, who are mostly amateurs in the business world and inveterate gamblers. Instead we need to train engineers to be professionals in the field of management, and competent to take large calculated risks. National science and engineering policies have to be developed too, but they will not solve our economic problems.

Creating Industries of Comparative Advantage

My experiences in creating innovative industries has revealed that there are many inadequacies in our economic, industrial and trade policies. The obstacles and frustrations to be faced are incredible.

As explained, a major problem is the fact that many leading U.S economists are saying modern macroeconomic theories are useless for solving the serious economic problems of society.[1-6]. Unfortunately none of them have produced acceptable recommendations as to what is to be done about this problem.

My perception is that the Japanese are using a <u>systems</u> approach to economic theory. This is borne out by a series of documents which used to be available in English from M.I.T.I. (Ministry for International Trade and Industry). The last one I was able to obtain was for 1976. The title of each document was "The Structure of Japanese Industry - A Long Range Vision", 1976. These documents are no longer available.

These documents were revised every year and they really represented a <u>business plan</u> for Japan's economy, similar to corporate business plans on this continent. I suggest that our economists are incapable of producing a similar plan for Canada's economy. A systems approach is definitely needed.

I would suggest that our macroeconomic theories need to be replaced with a new brand of economics called <u>systems economics</u> which will be a division of engineering. Policymaking is an activity which demands a professional approach, suited to engineering. Of all the groups in the universities, there is none more involved with industrial matters than the engineers. Industrial policy should be the responsibility of the engineering community.

I would like to see the meaningless concept called "technology" dropped from our vocabularies. If we mean engineering we should say so. We should be developing <u>science and engineering</u> policies, but mainly the latter one.

To illustrate what I mean by an engineering policy, consider the problems I faced when, as a professional engineer, I decided to create an innovative industry for Canada in ceramics. In 1974, SRL was offered the opportunity of entering the ceramic field, by purchasing a small company in Lindsay, Ontario called Almax Ceramic Industries Ltd. Almax had existed for ten years solely depending on annual grants from the Dept. of National Defence under a program called DIR (Defence Industrial Research).

The DIR program was one of the most useful ever developed in Ottawa, as it provided fully-funded grants to convert a laboratory model of a product into a commercial product. Sinclair Radio had used a DIR grant to develop a very sophisticated air navigation antenna, called DME (Distance Measuring Equipment). The SRL DME antenna is now used worldwide at airports, as standard equipment with the Philips DME package. It is the only DME antenna that fully conforms to the international standards.

SRL assembled a team of experts including an expert on mergers and acquisitions, to evaluate the Almax proposal. The team reported that Almax had:

1. no product,
2. no customers,
3. no financing,
4. no marketing,
5. no management after the entrepreneur died in 1973. Its only asset was an excellent group of research engineers.

The team also prepared a five-year business plan showing that to create an innovation would involve:

1. risk capital of $1 million, half of which could be obtained from federal and provincial sources.
2. five years of losses to create a viable operation
3. loss of most of the risk capital in the start-up period of five years.

They recommended against purchasing Almax.

In order to understand why I did purchase Almax, it is necessary to understand the difference between an entrepreneur and a professional engineer. Entrepreneurs are generally amateurs in the business field, as shown by the fact that about 8 out of 10 entrepreneurial ventures are expected to fail. I had 23 years experience in operating Sinclair Radio successfully. Also, entrepreneurs are pure gamblers, taking large risks,

usually with other people's money, hoping to make a fortune.

As a professional, I never gamble. I take only calculated risks, based on extensive experience. I do not start a new venture unless the odds for success are definitely in my favour. In the case of Almax, I knew that I could succeed, after 23 years of successful innovations in SRL.

When I purchased Almax, I accepted the team analysis but not their recommendation. I asked myself the question: what would happen after the five-year start-up period and I liked what I foresaw.

Almax Ceramics was purchased by SRL in 1974 and the name changed to Almax Industries. The purchase was based on a verbal promise from the Dept. of National Defence that the DIR grants would continue. Unfortunately, the entire DIR program was terminated in January 1975 for unstated reasons. Almax then faced a period of higher losses.

The Dept. of Industry, Trade and Commerce promised that a new program would be implemented, but it never materialized. Almax applied to NRC for an IRAP grant which was accepted. However, the NRC grants only pay about half the costs, so Sinclair Radio had to subsidize the research.

The immediate goal of Almax was to develop a sophisticated industrial ceramic called PZT (lead zirconate titanate), needed in the ultrasonic industry, and specifically for military sonobuoys used to monitor the movements of submarines.

In 1976, the Royal Canadian Navy ordered sonobuoys requiring PZT ceramic units. Almax desperately needed such a contact in order to develop proper production techniques. Hence Almax bid about $500,000 on the contract which was not enough to cover all the costs. The contract was awarded to a U.S company exporting to Canada. Since the material was for defence, it

entered Canada duty-free. The Almax bid was 15 percent above that of the imports.

The policy of the Dept. of Supply & Services was to pay no more than a 10 percent premium for domestic production, so Almax lost the contract. It was a severe blow to Almax.

I objected, pointing out that the very first action to be taken, if Almax received the contract, would be to establish an account to send to Ottawa each month substantial amounts of money for the withholding taxes on wages and salaries of employees. The imports would send nothing. Actually the employees would also pay many more taxes, such as cigarette, gasoline, liquor, sales taxes, etc, etc. A rough guess at these taxes would be 33 percent of the contract (based on the fact that in 1976 taxes represented 33 percent of our GDP). The imports being duty-free paid no taxes. In addition, Almax would have hired 30 employees for one year, taking 30 unemployed off the unemployment insurance benefits. The imports provided no jobs.

I estimated that the <u>real</u> net cost to the Canadian economy of purchasing the domestic product was not $500,000 but more like $100,000. The imports at about $430,000 were obviously too expensive. The D.S.S official responded that they do not get involved in socio-economic considerations.

Almax persevered and eventually began selling its product to U.S defence contractors, in spite of the fact that Almax had received no support from D.S.S.

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In 1979, it appeared that Almax might be profitable in 1980, so plans were made to initiate some new products, with the aim of making Almax into a complete ceramic industry. First it was decided to begin developing a

process to make a new ceramic called beta alumina. The Ford Motor Company of Detroit had invented a new storage battery, called the sodium-sulfur storage battery, for a proposed electric vehicle program. The key component was a ceramic called beta alumina.

An unsolicited proposal was sent to D.S.S. for $250,000 to fund a three-year R&D program at the Ontario Research Foundation. The proposal was accepted. The goal of the research was the development of a new device called a thermoelectric generator (TEG). The TEG was to be used to convert thermal energy to electric energy at an efficiency of 20 percent. The heart of the device is a beta alumina ceramic component.

Secondly, a request had been received from the U.S Dept. of Defence (via the Canadian Commercial Corporation in Washington) to consider a major expansion of Almax production facilities. The U.S Navy had been for 10 years developing a new generation of powerful sonobuoys called Q-62 and was nearing the point of issuing a production contract. Surveys had shown that the existing ceramic industry in the U.S would not have the capacity for producing the new Q-62 components in addition to producing the obsolete components. Almax was asked to manufacture the obsolete units so the U.S industry could concentrate on the Q-62.

Almax accepted the request and asked D.I.T.C in Ottawa for assistance. A promise of assistance was received but there was no action. Hence Almax had no choice but to appeal to the Eastern Ontario Development Corporation (a provincial agency) for a mortgage to expand the building, plus a request for a $500,000 bank loan for operating purposes. The loan was approved by the company bankers. George Sinclair was requested to provide his personal guarantee on the loan, but successfully avoided it. However the loan had to be guaranteed by Sinclair Radio.

Thirdly, Almax personnel realized that while production of the obsolete units could be expected to last for about 8 years, it was obvious that a project should be initiated to develop the expertise to make the new Q-62 units. An IRAP grant was obtained.

In 1982, due to circumstances beyond the control of Almax, its U.S customers placed no substantial orders, resulting in a serious cash flow problem. The book value of the company dropped to zero, showing that the initial risk capital had disappeared, and in addition there was the $500,000 bank loan. The bank suggested receivership, but I decided to rescue the operation by injecting $200,000 of new equity. This was based on a forecast of profitable operations in six months. The forecast was accurate. The injection of new equity was another <u>calculated risk</u>.

In 1983, the U.S Dept. of Defence placed a contract for the first production of Q-62 sonobuoys. There was great surprise in the U.S ceramic industry when an unknown company in Canada called Almax, was awarded 40 percent of the production of the new Q-62 PZT ceramic units. The manufacturers of the sonobuoys were pleased to discover there would be a second source for the ceramic.

The original Q-62 units were developed by a U.S company over a ten-year period under <u>fully-funded</u> military contracts. The company felt secure in its monopoly, expecting competitors would require 10 years also to develop a competing unit. Almax, with its IRAP partial-funding grant, only took 3 years to develop a superior component.

Today Almax is the major supplier of Q-62 units and it dominates the industry, setting the standards for price, quality and delivery. It is the U.S industry that is now making most of the obsolete units.

Today, Almax has a successful TEG and is life-testing a commercial unit, which is five years ahead of any U.S product. At a recent seminar at the Jet Propulsion Laboratory, Almax astounded the attendees (who were from the Sandia Corp, NASA, McDonnell Douglas, and Westinghouse) by showing a commercial TEG which their companies were hoping to develop by 1991.

The U.S research laboratories had sizeable research budgets, of the order of several million dollars per year, and teams of research personnel. Almax engineers pointed out they had a budget of only $100,000 and it took two engineers to develop the TEG. This is another illustration of the key role of engineers in creating industrial innovations. The U.S research personnel were devoting much effort to theoretical analyses of potential problems in building a TEG. The Almax personnel did most of their research in the laboratory finding practical solutions to the problems.

At present Almax is expanding its PZT operations, partly to serve an expected large European market, and partly to serve an expanding U.S market. It is also building a new facility for research and pilot plant production of new high-temperature ceramics, including beta alumina and silicon nitrides which are expected to find extensive application in the automotive market. A new facility for a new ceramic called zirconia-toughened alumina (for the hard-rock mining industry) is being planned.

Almax recently was awarded the Business Achievement Award of the Ontario Government, for industrial innovation. Almax is clearly a world leader in the field of sophisticated industrial ceramics, and is a good candidate for becoming a major industry of comparative advantage.

A continuing frustration in Almax has been the delegations sent overseas to Japan and to Europe by federal and provincial ministers, seeking to induce Japanese and European ceramic companies to come to Canada to share their

ceramic technology. The world leader is already here in Canada.

Conclusions

Experience in Almax has shown that:

a. Canadian industry does not need to depend on imported technology. Canadian engineers are the equal of the world's best when given the opportunity to show their capability.
b. Canadian manufacturing industry does not need free trade to have free access to the huge U.S market. The huge U.S defence market is already available duty-free.
c. The small size of Canada's defence market was not a serious handicap. Almax was created to serve the U.S defence market.
d. Almax was deliberately created to become an industry of comparative advantage. It was created by a human being, George Sinclair, when he decided to take a large calculated risk, losing one million dollars to create the industry. Science and technology, no matter how defined, had nothing to do with it. The R&D followed the decision to create the industry. There was no "diffusion" of technology.
e. The success of Almax was largely due to using an engineering approach instead of a scientific one.

In order to develop the discipline of economic systems engineering, it is essential to develop a large body of empirical data, assembled from economic experiments in the development of new industries, similar to the SRL and Almax experiments. Proper business plans, prepared by professionals (engineers, lawyers, corporate managers and venture capitalists) must be prepared and updated regularly.

The inadequacies of current economic theories must be recognized and corrected. Our current economic goals, including

free trade
protectionism
science and technology
entrepreneurship

must be abandoned and replaced by a single target of reasonable rates of economic growth.

Our present macroeconomics policymakers have the wrong expertise for producing economic growth. Economic growth is a phenomenon in the field of microeconomics, so new theories need to be developed. What is wrong with <u>macro</u>economics is that it is, <u>by definition</u>, concerned with the symptoms (aggregates of economic variables) of <u>micro</u>economic activities.

All of our macroeconomic policies are designed to cure the symptoms of deeper problems, which have not been fully recognized. Our basic economic problem is the lack of economic growth. Creating economic growth is partly a matter of microeconomics, but it is much more a phenomenon in the field of economic systems. Without a sympathetic economic environment, microeconomic policies are not likely to be effective.

TABLE I

Average Annual Rates of Economic Growth

1979-1984

Japan	4.0 percent
U.S.A.	2.0
Canada	1.7
France	1.1
Italy	1.1
Germany	0.9
Britain	0.6

OECD Obs. March 1986

TABLE II

1985 Taxes and Unemployment

Country	Taxes % of GDP	Unemployment Rate
Britain	42.9%	11.6%
Canada	39.6	10.4
Italy	45.0	10.2
France	48.4	10.1
Germany	45.6	8.5
U.S.A.	31.7	7.4
Japan	29.9	2.7

TABLE III

Employment in Service Industries

Canada	68.8 percent
U.S.A.	68.2
Britain	64.5
France	59.1
Japan	56.3
Italy	53.6
Germany	53.1

OECD Obs. March, 1986

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EXECUTIVE SUMMARY

SCIENCE, TECHNOLOGY AND INNOVATION IN THE MINERALS AND METALS SECTOR

by

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President, The Mining Association of Canada

and

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Presented to

CANADIAN FORUM ON A NATIONAL SCIENCE AND TECHNOLOGY POLICY

Winnipeg
June 8 - 10, 1986

SCIENCE, TECHNOLOGY AND INNOVATION

IN

THE MINERALS AND METALS SECTOR

EXECUTIVE SUMMARY

Over the past years, the mining industry had to go through a very difficult situation marked with plummeting consumption and commodity prices. To survive, companies had no choice but to apply stringent cost control measures and improve productivity.

Second to tighter management, innovation, with the introduction of changes and improvements in ways and means of carrying out mining, has been the key factor in increasing and achieving better productivity.

To stay the lowest-cost producers, productivity improvements must be realized on a continual ongoing basis and implementation of new technology is crucial in this regard. This is an area where Canada and our industry could and should do more and this is why the MAC is proposing the formation of "Centres of Innovation for Mining Systems" like the ones that have been established in the United States.

Yet, several useful initiatives are conducted but industry, governments, and universities are having a hard time organizing for closer and more efficient cooperation.

The industry believes that it is in the best position to provide the necessary leadership and is indeed prepared to take on that role through The Mining Association of Canada.

Our challenge is to put the following elements together:

- Emphasis on university research;
- The need for closer identification of university research with successful innovation;
- More cooperation and support from the industry in directed work with universities and government institutions;
- Sharper focus on industry priorities from government laboratories and granting agencies;
- Governments support of appropriate applied work in universities and industry through, among other means, grants and contracts.

To achieve these objectives, the MAC has launched a technology coordination initiative in proposing the establishment of an institutional structure dedicated to planning, promoting, priorizing, and carrying out a coordinated approach to mineral industry innovation.

Under the guidance of The Canadian Institute of Advanced Mineral and Metal Technology (CIAMMT), being made up of eminent persons in the sector, the scheme would also comprise several university-affiliated <u>specialized technology centres</u> which, along with government laboratories, would be expected to direct and <u>to coordinate</u> their efforts along the lines agreed by the CIAMMT.

It is anticipated that the main source of funds for operation will be provided on a matching basis by government and industry. "Sponsors" are defined as both of these funding agencies plus the host and affiliated universities.

For the MAC, the elements underlined above represent the essential principles upon which a new national science and technology policy should be developed.

SCIENCE, TECHNOLOGIE ET INNOVATION
DANS
LE SECTEUR DES MINÉRAUX ET DES MÉTAUX

PRÉCIS ADMINISTRATIF

Ces dernières années, l'industrie minière a traversé une période très difficile caractérisée par une chute de la consommation et des prix des produits de base. Pour survivre, les sociétés minières n'ont pas eu d'autre choix que de recourir à des mesures énergiques de contrôle des coûts et d'accroître leur productivité.

Outre une gestion plus rigoureuse, le facteur clé de l'accroissement de la productivité a été l'innovation, qui a permis de modifier et d'améliorer les méthodes et les moyens à la disposition de l'industrie minière.

Pour qu'un producteur maintienne les prix les plus bas, il doit accroître sans cesse sa productivité et, pour ce faire, il est essentiel qu'il intègre la nouvelle technologie. Or, il s'agit là d'un domaine où le Canada et notre industrie pourraient et devraient être plus actifs. C'est pourquoi l'AMC propose la création de "centres d'innovation des systèmes d'exploitation minière" analogues à ceux qui ont été mis sur pied aux États-Unis.

Certes, l'industrie, les gouvernements et les universités ont amorcé plusieurs initiatives utiles mais éprouvent encore de la difficulté à s'organiser pour coopérer plus étroitement et plus efficacement.

À cet égard, l'industrie croit être la mieux placée pour assurer la coordination nécessaire et elle se déclare prête à assumer ce rôle moteur par l'intermédiaire de l'Association minière du Canada.

Notre défi consiste à articuler les éléments suivants :

- intensifier la recherche universitaire;
- associer davantage recherche universitaire et innovation fructueuse;

- favoriser une collaboration et un soutien plus actifs de la part de l'industrie dans les travaux de recherche dirigés avec les universités et les institutions gouvernementales;

- orienter plus précisément les travaux effectués dans les laboratoires gouvernementaux et les décisions des organismes de subvention vers les priorités de l'industrie;

- s'assurer le soutien du gouvernement aux travaux de recherche appliquée pertinents effectués dans les universités et dans l'industrie par l'octroi de subventions et la sous-traitance, entre autres moyens.

Pour atteindre ces objectifs, l'AMC a lancé une initiative de coordination technologique en proposant l'établissement d'une structure institutionnelle qui se consacrerait à la planification, à la promotion et au choix des priorités nécessaires à l'établissement d'une approche coordonnée de l'innovation dans l'industrie minière.

Sous la direction de l'Institut canadien de technologie avancée des minéraux et des métaux (ICTAMM), qui se compose de représentants éminents des secteurs concernés, cette structure comporterait plusieurs centres de technologie spécialisée affiliés à des universités, qui, de concert avec les laboratoires du gouvernement, seraient appelés à orienter et à coordonner leurs efforts selon les lignes directrices de L'ICTAMM.

Cette structure serait principalement financée à égalité par le gouvernement et l'industrie, qui seraient les "parrains" du projet, au même titre que les universités hôtes et affiliées.

Le présent document résume les principes fondamentaux qui, selon l'AMC, devraient sous-tendre l'élaboration d'une nouvelle politique scientifique et technologique nationale.

SCIENCE, TECHNOLOGY, AND INNOVATION

IN

THE MINERALS AND METALS SECTOR

By

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INTRODUCTION

The Mining Association of Canada (MAC) is the national organization of Canada's mining industry. Its 75 member companies account for the great bulk of Canada's production of metals and industrial minerals.

The mining industry has gone through five extremely difficult years. During the recession, the consumption and prices of mineral commodities collapsed. Consumption has recovered to pre-recession levels. But prices of many metals expressed in North American currencies are still very low. Mining companies survived only because of stringent cost control and improved productivity.

The MAC estimates that, across the whole industry, the amount of product per man-year has increased by almost 50 per cent since 1981. This achievement made possible the production of all-time record values of output in 1984 and again in 1985. Employment in our industry, which was severely curtailed in 1982 and 1983, has recovered close to the 1979 level.

This productivity increase was due mainly to tighter management but also partly to the introduction of novel mining methods.

We believe there is still scope for fundamental, quantum improvements due to entirely new technologic approaches.

Unfortunately, research, as well as the development of new technology, has been cut back within industry in recent years for economic reasons. Yet the imperatives of modernizing the industry, increasing productivity, and winning markets are clearer than ever. In a situation of constrained internal and public resources, closer coordination of the innovative efforts of industry, government and the universities is essential.

We believe that the essential principles in a new science and technology policy must be:

- involvement of industry, government and universities;
- coordination of effort among them;
- specialization among institutions;
- focus on industry's needs.

The application of these principles to the minerals and metals sector will be illustrated by reference to a specific initiative of the Association.

Throughout this paper, the use of "science and technology" are intended to convey the concept of "innovation": the successful economic application of the findings of scientific research. From our viewpoint, at this time in Canada's history, the greatest need is to make effective practical use of what we know or what we can learn. All our recommendations should be read in that light.

CHALLENGE TO THE MINERALS AND METALS SECTOR

In a recent speech, one of us (Curlook) reviewed some of the tasks facing this industry as it attempts to maintain or improve its cost-competitiveness with world producers. The message was that Canada must strive to be the best in the business.

Being "best" in a metals commodity business is being "lowest cost". In international commodity markets, particularly in markets that are consistently and persistently oversupplied, being the lowest cost producer, over the long run, is our only security. In a business and economic environment, where as much as 50% of total costs are employment costs, productivity improvement is the main route to lower costs. Productivity improvements come from changes and improvements in many areas: in methods, technology,

equipment, simplification, work reorganization, job restructuring, computerization, automation. In order to make quantum improvements in productivity and achieve significant reductions in costs, we must concentrate on all of these areas at the same time. In order to stay the lowest-cost producers, we must effect productivity improvements on a continual ongoing basis.

Continuing improvements depend critically on the implementation of new technology. Canada is lagging in this respect. Our industry can and must do more. Accordingly, The Mining Association of Canada is proposing the formation of "Centres of Innovation for Mining Systems".

Consider the situation next door in the U.S.A. There are some interesting developments in the advancement of mining technology. The Colorado School of Mines has taken the initiative of establishing an "Engineering Research Centre in Advanced Mining Systems". The Centre will focus on automated mining systems, autonomous equipment, innovative mining methods, in-situ extraction, computerized management information systems and innovative fragmentation processes. Also, three new courses will be offered at the School starting in 1986: one is "New Techniques in Mining", another is "Mine Automation", and a third, "Mobile Robotics". This subject matter clearly describes the orientation of their thinking and forward programs.

In a separate initiative, the Massachusetts Institute of Technology (MIT) and Pennsylvania State University (Penn State) through a joint research and education program are establishing a "Centre for Innovative Mining Systems". Initial research at this Centre will focus on ways of simplifying underground mining systems and utilizing remote control and innovative machines and methods to mine in a truly continuous and faster fashion. The founders feel that the past, slow, evolutionary pace of innovations in mines, where each small change is grafted onto existing mine systems and constrained by traditional practices, is unsuitable for

accommodating the revolutionary developments in sensing and control and computerized technology that have occurred in recent years. Research is planned into robotics and artificial machine intelligence. The founders feel that one of the keys to success is that industry has to be fully involved.

Realizing that innovative research in excavation is a broad objective, exceeding the capability of any one or two institutions such as MIT or Penn State, the MIT/Penn State Centre for Innovative Mining Systems has proposed to join with other universities and the American Society of Mechanical Engineers to form a technology group designated as the "Institute for Innovative Excavation Equipment and Systems" (the "IIEES"). We see emerging in the U.S.A., a mammoth cooperative research and development program. Universities are working closely with industry, with support expected from the National Science Foundation, in a program directed at safer and more productive excavation methods.

Contrast our approach in Canada. We are not doing enough in this area. Industry, governments, and universities are having a hard time organizing for cooperation.

There are several useful initiatives but they are not coordinated. There is, for example, a fund-raising campaign in support of two industrial chairs at Laurentian University, one in the field of Ground Control/Rock Mechanics and a second in the field of Geochemical Exploration/Remote Sensing. Moreover, the Mining Department at McGill has been looking for a candidate to fill an already-endowed chair in Mining Robotics and Automation. Queen's Mining Department is also considering taking some new initiatives. Industry supports these programs.

However, there is a concern, and indeed some evidence, that our universities are setting off on separate tangents and in a real sense are competing for increasingly scarce dollars. What seems to be required is a measure of coordination and a measure of integration in the installation of new research facilities and in the development of new programs. To get the maximum benefit for our dollars and efforts and to speed up the process will require close cooperation between Canadian universities, governments and industry.

The question is, who is in the best position to provide the necessary leadership and coordination. We believe that industry itself has the best window on the future, and we in The Mining Association of Canada are prepared to take on that leadership role.

The emphasis on university research is deliberate. Much closer identification of university research with successful innovation is clearly required in Canada. At the same time, industry must cooperate more closely with, and be prepared to support, directed work in universities and government institutions. Government laboratories and granting agencies must focus more consistently on industry priorities. They must also support appropriate applied work in universities and industry by a variety of means, including grants and contracts.

Our challenge as a nation is to put all this together.

MAC TECHNOLOGY COORDINATION INITIATIVE

The Mining Association of Canada has begun a series of discussions within industry, as well as with both senior levels of government and universities, to promote a coordinated approach to mineral industry innovation.

A schematic representation of an institutional structure is presented in Figure 1. First, there is a national board or institute named, for purposes of discussion, "The Canadian Institute of Advanced Mineral and Metal Technology" (CIAMMT). This is not a brick-and-mortar institution, but rather a committee of eminent persons meeting several times a year. Its purpose would be to establish elements of national technology strategy in support of this sector. Membership would include representatives of industry, government, and universities, together with the Directors of several specialized Centres (described below). National research priorities would be established.

CIAMMT would have no direct granting authority. However, a granting agency such as NSERC would be expected to exercise its authority in line with priorities and strategies established by CIAMMT. Government laboratories, as well as a series of specialized Technology Centres, would be expected to direct their efforts along agreed lines.

The Technology Centres would all be established at a university location. Each would be affiliated with its host university for purposes of support and administration. A Technology Centre would normally be affiliated with one or more additional universities for purposes of sharing facilities, accreditation for research towards advanced degrees, and so on.

It is anticipated that the main source of funds for operation will be provided on a matching basis by government and industry. "Sponsors" are defined as both of these funding agencies plus the host and affiliated universities.

Each Centre would be governed by an independent Board of Directors representative of the Centre's sponsors, and responsible for operating policy and management. Each would have an Advisory Council, consisting of knowledgeable researchers, to provide program advice and coordination. Quality of Director and staff will be critical to the success of each Centre.

This form of support and governance is modelled after that of the Centre for Resource Studies (C.R.S.), a highly successful policy research institute located at Queen's University and sponsored by Energy, Mines and Resources Canada, Queen's University, and The Mining Association of Canada. C.R.S. has demonstrated that a cooperative approach among three sponsors can result in timely, high-quality work, applied to significant problems. The independence of the university is not compromised, but the research is focussed on the issues facing the industry.

Each Technology Centre would be regarded as a national institution, a national centre of excellence. As such, it would carry out some work in-house, but would also support work at affiliated universities and at other universities, where appropriate, across the country. In this way it would exercise a benign leadership and coordinating influence on other institutions.

To be successful, this system will require the cooperation of agencies which are accustomed to autonomy. However, the partial surrender of autonomy can also yield enormous benefits to participating institutions:

- the possibility of increased funding, especially from industry;
- more effective, faster innovation in Canada;
- the opportunity for academics and government researchers to be associated with commercial application of their discoveries;
- much more efficient use of scarce financial and human resources.

We have another example in Canada, besides C.R.S., of cooperative research between several universities, the government

and industry, and that is IREM-MERI, "Institut de Recherche en Exploration Minérale - Mineral Exploration Research Institute". It was established in 1972 with a mandate to serve as a national centre of excellence in the field of mineral exploration research. It combines the resources of the geology and geological engineering departments of Ecole Polytechnique, McGill University, and Université de Montréal, and serves as the facility through which these departments interface with government and industry. Representatives from the three universities, from the provincial and federal governments, and industries working in Quebec, sit on the Institute's Board of Directors. The work of the Institute could be enhanced by greater participation by industry. Also, the question arises as to whether its scope can be expanded beyond the province of Quebec. For this to happen, it will require the affiliation of other Canadian universities and industry from outside of Quebec. This Institute rightfully falls under the caption "Centre(s) for Geochemical and Geophysical Exploration Technology".

Another question, yet to be answered, is whether in certain disciplines there should be more than one Centre.

The MAC believes that Canada's situation calls for a cooperative approach to technology development and implementation. We are confident that battles over "turf" will be infrequent, brief, and minor. The intrinsic benefits speak for themselves. Initial discussions with the potential actors indicate that cooperation will be forthcoming in the broader interest of Canada.

RESPONSE TO FORUM QUESTIONS

No doubt MAC's answers to the questions posed by the Forum's organizers are largely implicit in the proposal previously described. Hoswever, for greater certainty, specific answers are provided here to several of these questions.

Developing and Acquiring New Knowledge

1 (a) Q. Is Canada getting maximum benefits from money spent on university research? If not, what steps should be taken to improve the situation?

A. No. More focus on industry problems is needed through joint or industry-sponsored research. University researchers should go looking for applied problems.

(b) Q. If new money were to become available, should it be used for university research, and if so, how should it be spent to assure maximum benefit to the country?

A. Yes. Use it to provide specific incentives to approach applied industry problems. Subsidize the familiarization process.

(c) Q. Are you satisfied with the rate of progress toward university-industry cooperation in science and technology? Should it be further encouraged, and if so, how can we foster better linkage between the private sector and universities?

A. No, I am not satisfied. Industry must stop ignoring an important resource. Universities and industry must re-awaken researchers' interest in practical problems through encouraging consulting and joint research.

(d) Q. How can your organization help Canada to develop our intellectual capital so that it can be applied to Canada's needs? So that Canada can acquire new knowledge? In the training of highly-qualified personnel?

A. See the preceding sections of this paper.

2. (a) Q. Is Canada getting maximum benefits from money spent on government laboratories? If not, what steps should be taken to improve the situation?

A. No. Closer coordination is needed between industry and government laboratories.

2. (b) Q. If new money were to become available, should it be used for government laboratories? and if so, how should it be spent to assure maximum benefit to the country?

A. No.

(c) Q. Are you satisfied with the rate of progress toward government-industry cooperation in science and technology? Should it be further encouraged, and if so, how can we foster better linkage between the private sector and government laboratories?

A. No, I am not satisfied. See preceding sections for suggestions about encouraging linkage.

3. (a) Q. International benefits?

A. The mineral industry is an international industry and an international market for technology. There is already effective technology transfer across borders.

Putting Knowledge to Work and Realizing Opportunities

4. Q. Should Canada target its science and technology resources in a range of strategic areas so as to maximize return? If so, how?

A. Yes. See preceding sections.

5. Q. What can government do to make sure that Canada's companies are using the best available technologies? What can your organization or sector do to help?

A. Both parties should agree to support cooperative structures as proposed here.

6. Q. Diffusing technologies?

A. The mineral sector has begun to reach out to suppliers (and potential suppliers) of new technologies. Innovation is now encouraged in some of our larger mining companies.

7. Q. Encourage linkages?

A. Linkages are strengthening rapidly in the mineral sector as a result of recent initiatives by government and industry. Examples are technology exchange agreements between mining companies and high-tech manufacturers, familiarization tours for high-tech suppliers to mines, coordination of a Canadian position on mining automation by a tripartite committee that was recently formed.

8. Q. Pre-venture capital?

   A. N/A

Adapting to Change

9. Q. Help Canadians deal with change?

   A. Good question. Provide maximum information to individuals. Assist individual transitions and retraining. Avoid perpetuating institutions in their present form when they are inappropriate to changing conditions. This applies equally to corporate bailouts and preservation of communities that have lost their economic base.

10. Q. Regional balance?

   A. Do nothing to promote regional balance. Let the market work. The mineral sector has its own regional imperative. (Mines are where you find them). It cannot be modified, except at great cost. This may be equally true of technology-driven developments. Flexibility and adaptability are to be valued more highly than regional balance.

11. Q. What measures need to be taken to enhance the joint collaboration of labour and management in the introduction of new technologies?

   A. Industry and government should provide information well in advance. Introduce early consultation and joint planning for change. Protect individuals from the worst consequences of technologic change. Give them initiatives and help to adapt.

Putting a National Science and Technology Strategy to Work

12. Q. Roles of the actors?

   A. See preceding sections.

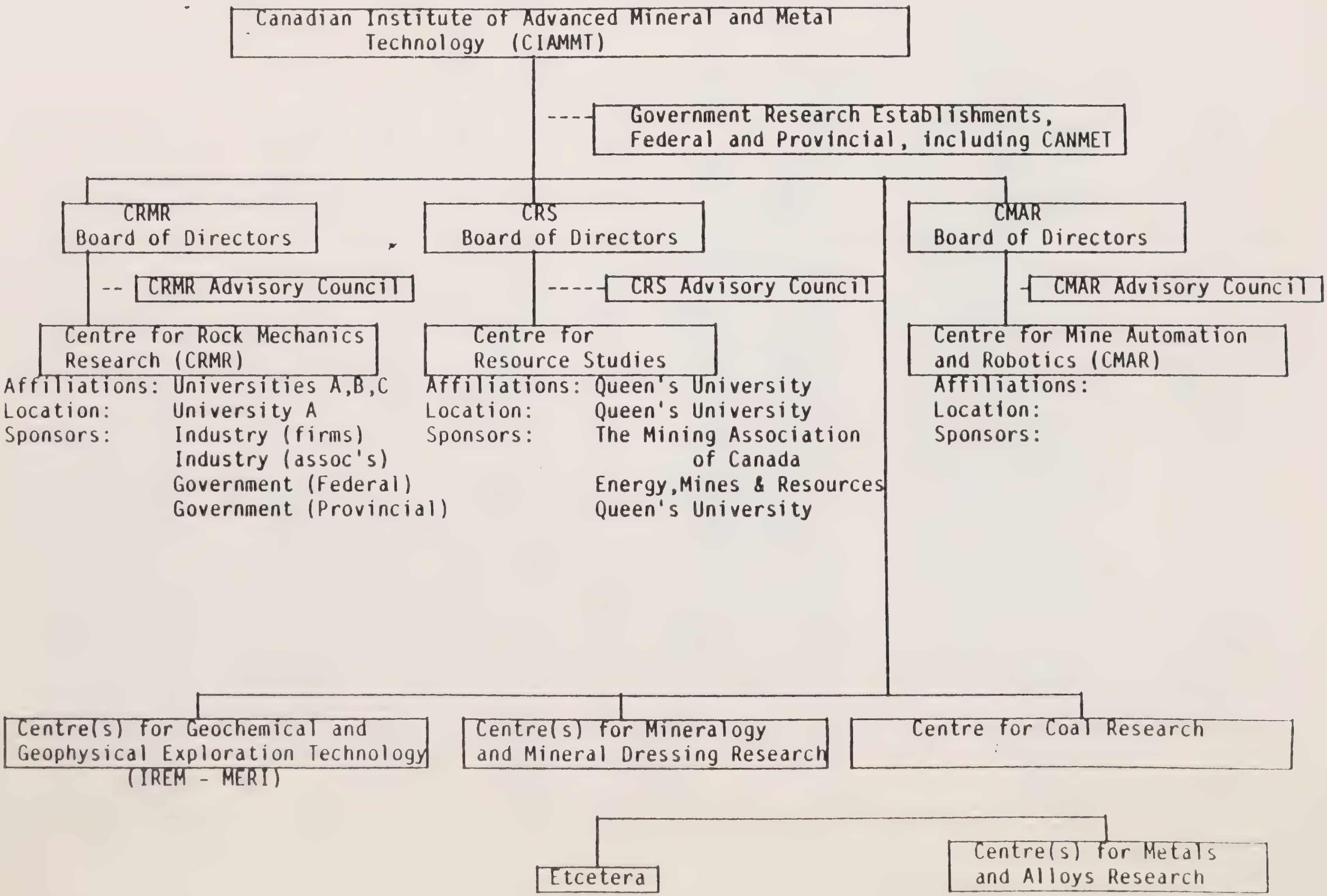
13. Q. Coordination and collaboration?

   A. See preceding sections.

14. Q. Other suggestions?

   A. None.

Figure 1. A Schematic Proposal For an Integrated Applied Mineral Research System



DOCUMENT: 830-220/029

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

<u>The Elaboration of a National Science and Technology Policy:
The Participation of the Scientific Community</u>

The National Consortium of Scientific and Educational Societies

June 8-10, 1986
Winnipeg, Manitoba

The National Consortium
of Scientific and Educational Societies

Le Consortium National
des sociétés scientifiques et pédagogiques

1001-75 Albert, Ottawa, Ontario K1P 5E7 Tel.: (613) 237-6885

Ottawa, June 2, 1986

Mr. John Gundy
Ministry of State for
Science and Technology
C.D.Howe Bldg. 8th floor West
235 Queen St.
OTTAWA, Ont.
K1A 1A1

RE: Forum for the Developkent of a National Science and Technology Policy

Dear Mr. Gundy:

Further to our telephone conversation of May 23, I enclose a brief prepared by the National Consortium of Scientific and Educational Societies for the Forum on the National Science and Technology Policy.

I would like to apologize for the delay and thank you for your patience.

Yours sincerely,

Clément Gauthier

Clément Gauthier, Ph.D.
President, NCSES

CG/fp

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of Scientific and Educational Societies

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The Elaboration of a National Science and Technology Policy:
The Participation of the Scientific Community

Brief submitted by

The National Consortium of Scientific and Educational Societies

to

The Minister of State, Science and Technology

at the

Canadian Forum on National Science
and Technology Policy

Winnipeg, June 8-10, 1986

By: Clément Gauthier, Ph.D.
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By: Clément Gauthier, Ph.D.
President

The National Consortium of Scientific and Educational Societies (NCSES) welcomes the joint initiative of federal, provincial and territorial ministers of science and technology, to organize the "Canadian Forum on a National Science and Technology Policy". We are most happy to take part in such an historical event which, we hope it, will give an impulsion to our long awaited national policy on research and development (R & D).

The National Consortium is composed of 30 organizations representing some 55 000 researchers and university teachers, as well as the 400 000 members of the Canadian Federation of Students. The Consortium has been active since 1976. Its main purpose is to share information and exchange views on issues of concern to the scientific and student community with respect to Canadian policies on R & D and post-secondary education. The following organizations are members of the National Consortium of Scientific and Educational Societies:

- Association for the Advancement of Science in Canada
- Association of Canadian Universities for Northern Studies
- Association of Universities and Colleges of Canada
- Biological Council of Canada
- Canadian Association of Graduate Schools
- Canadian Association of Physicists
- Canadian Association of University Business Officers
- Canadian Association of University research Administrators
- Canadian Association of University Teachers
- Canadian Bureau for International Education
- Canadian Council of University Biology Chairmen
- Canadian Federation for the Humanities
- Canadian Federation of Biological Societies
- Canadian Federation of Students
- Canadian Geoscience Council
- Canadian Institute of Food Science and Technology
- Canadian Medical Association
- Canadian Psychological Association
- Canadian Society of Clinical Investigation
- Canadian Society of Microbiologists
- Canadian Society for the Study of Education
- Canadian Union of Educational Workers
- Canadians for Health Research
- Chemical Institute of Canada
- Council of Canadian University Chemistry Chairmen
- Institute of Electrical and Electronics Engineers-Canadian Region
- Professional Institute of the Public Service of Canada
- Science Council of Canada
- Social Science Federation of Canada

Question 1 a: Is Canada getting maximum benefits from money spent on university research? If not, what steps should be taken to improve the situation?

No, because a portion of the federal transfers under the Established Programs Financing Act (EPF) to Post-secondary Education is used by the provinces for other sectors of activity. These funds are needed to cover the so-called "indirect costs of research", such as space, utilities and salaries. Moreover, the Federal Governement recently announced a unilateral cut to EPF amounting to a cumulative total of $5.5 billion by 1990. For fiscal year 1986-87, this cut amounts to $102,4 extra million for the Federal Government. The budgets of the granting agencies increased by $25 million while the full funding of the Five-Year Plans would have required $258,1 million more. As a result of successive cutbacks by the provincial and federal governements, the Canadian university system is on the brink of disaster: since 1977-78, full-time equivalent enrolment in Canadian universities has increased by 24%, while real expenditures per students in constant dollars have decreased by 18%.

RECOMMENDATION

In order to prevent the provinces to further retrenchment of the support to the universities, the Federal Governement should not proceed with its proposed modifications to the EPF (Bill C-96). Rather, there should be a First Ministers' meeting called to discuss solely the state of higher education in Canada

RECOMMENDATION

Being given that the basic research done almost exclusively in universities is, and should be a federal priority, the National Consortium recommends that the new Standing Committee of the House of Commons on Research, Science and Technology study both the direct and the indirect costs of research, as well as other matters deemed pertinent to post-secondary education that are related to university research, either directly or indirectly.

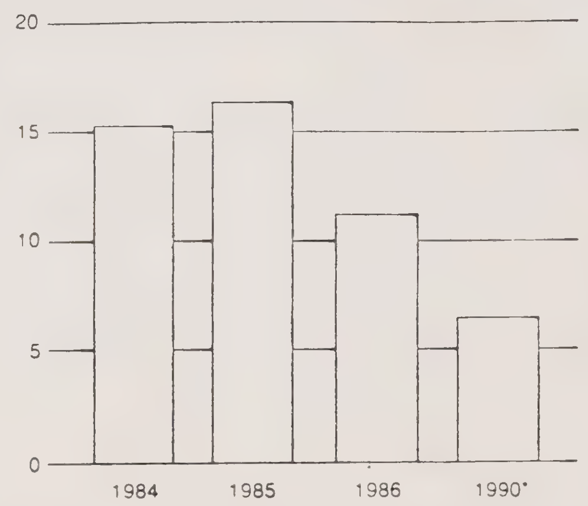
Question 1 b: If new money were to become available, should it be used for university research?

Yes, since (i)"University laboratories can and should be leaders in the area of basic research and that...(ii) post-secondary institutions remain our prime source of the trained personnel needed by a dynamic society" (David G. Vice, President of Northern Telecom Ltd, Building on Our Strengths, MOSST, 1986).

Unless basic research (R) gets the critical mass of investments that is required, Canada will miss the opportunity to develop its tremendous potential.

In Canada, the three federal granting councils are the primary supporters of university research, under 1% of total current university expenditures being provided by corporate support of university R & D (Building on Our Strenghts, MOSST, 1986). Moreover, a Conference Board of Canada study published in February 1986 showed a substantial reduction in the rate of growth of corporate R & D spending intentions for 1986. As the following diagram illustrates this trend carries through to the 1990's. On the basis of these preliminary remarks, we would like to proceed with our assessment of the five-year funding plan for the granting councils which the government made public last February.

Chart 2
R and D Spending Intentions, All Respondents



*Average annual compound rate of growth from 1986 to 1990.

Source: The Conference Board of Canada.

Assessment of the Funding Plan for the Granting Councils (Feb. 1986)

Firstly, we welcome the government's commitment to provide the granting councils with stable, though inadequate, funding at a level equivalent to their total 1985-86 budgets.

Secondly, the increases of 4%, 4% and 10% originally allocated to the MRC, NSERC and SSHRC respectively for FY 1986-87 were perceived as a step in the right direction. As it turns out however MRC will receive only a 2% increase as a result of a 2% cut imposed by the Department of Health and Welfare. According to our understanding originally this 2% budget reduction was not to be applied to MRC. Moreover, since the February announcement

NSERC has had to assume new responsibility for part of the funding of a programme which until recently had been funded and administered by the Canadian Forest Services. NSERC must now transfer to the Canadian Forest Services programme some $3.6 annually during the next two years, without being provided with additional resources, thereby bringing its effective increase down to 2.8% from 4%. Such an extension of responsibility without additional resources constitutes an unacceptable practice which seriously hinders the planning activities of the Councils, not to speak of inducing the Canadian public in error concerning the increases actually allocated to R & D.

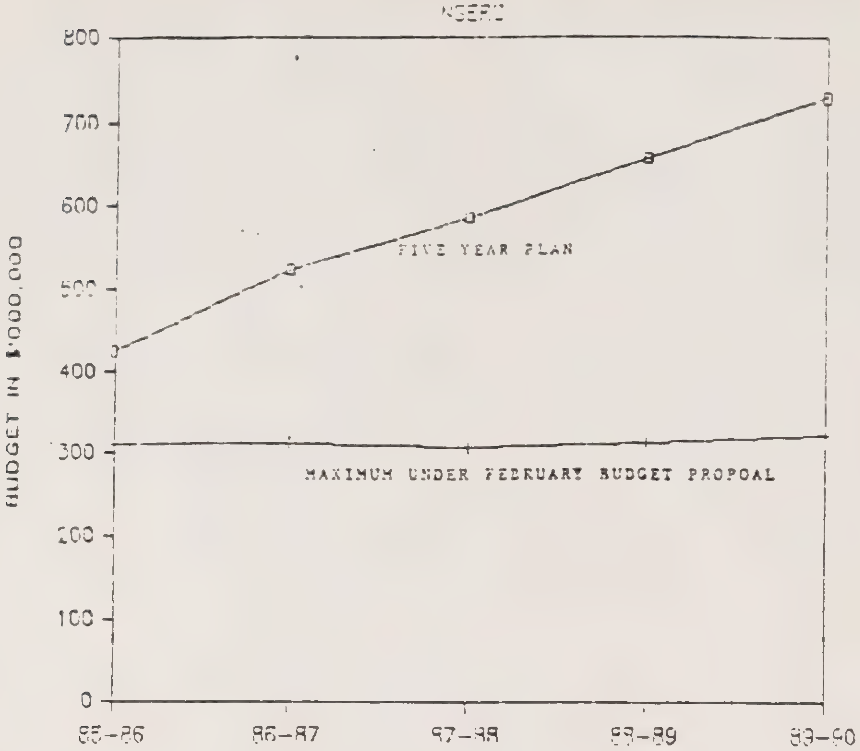
Thirdly, we wish to express the following reservations regarding the funding plans. On the one hand, all figures are in current dollars and no provision is made for inflation, which will probably be around 4%. On the other hand, according to the current funding plan, any real increase in the Councils' budgets must come through private sector contributions, which will then be matched by the federal government. The Conference Board of Canada study cited above establishes that the projected corporate investments (under 1% of the university expenditures) in R & D will decrease in the years to come. Moreover, although the guidelines for implementing the new policy are not yet known, the indications contained in the February 1986 Budget Papers lead us to believe that the programme might be conceptually flawed and that it may not be able to meet its declared objectives.

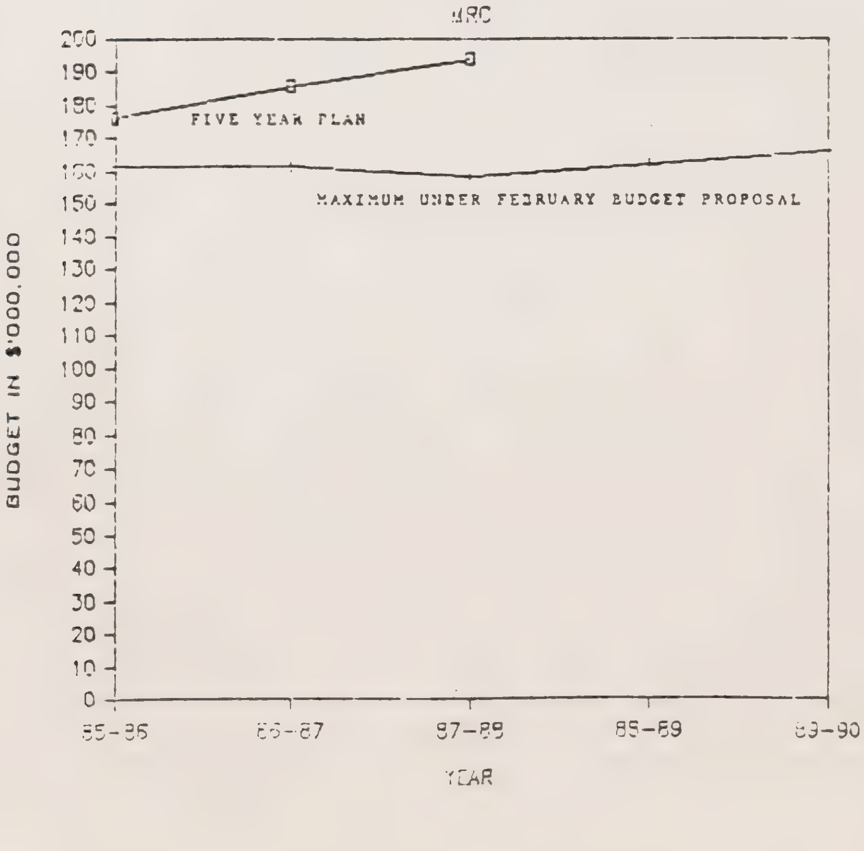
A case in point is the exclusion of the Social Sciences and Humanities from the definition of "scientific research" for the purpose of the Income Tax Act. Even if this exclusion was done away with, it is not likely that the private business sector would be willing and able to support research in the social sciences and humanities at a level proportionately comparable to that of the natural sciences. To a lesser degree , medical research faces a similar problem in view of the fact that the only significant source of private funds is the pharmaceutical industry, which is cutting back on its support of R & D performed in Canada. In both instances it is of paramount importance that a literal definition of the private sector be avoided.

Fourthly, the Consortium is extremely disappointed that the government appears to have discarded the very carefully prepared realistic Five-Year Plans of the three granting councils. The unanimous support of the academic community for these Plans as well as the extremely good record of the granting agencies with respect to the administration of their programmes and the disbursement of public funds are the best guarantees the government could ask for. Without Five-Year Plans, it is difficult to see how our national objectives in terms of R & D can be pursued.

The graphs shown below illustrate the increasing discrepancy between the Councils' budgets under the Five-Year Plans and the maximum amounts possible according to the February 1986 funding plan. We have included the matching funds that would eventually be granted by the federal government. We have not, however, included the private sector contributions. These latter contributions will in effect be tied to specific research contracts and therefore will not be available to the research councils for the support of their basic activities.

5-YEAR PLAN VERSUS FEB. 86 BUDGET





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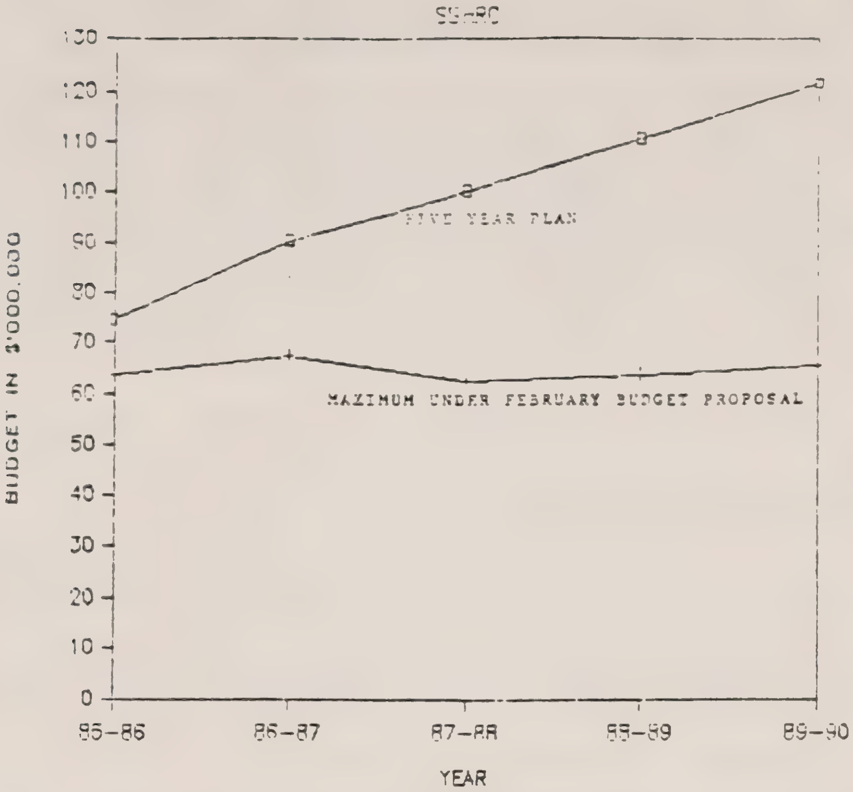


ALL FIGURES IN CONSTANT 1985-86 DOLLARS
INFLATION ASSUMED TO BE 4% PER YEAR

MAXIMUM MEANS APPROVED BUDGETS PLUS BUDGET INCREASES PLUS FULL FEDERAL MATCHING OF PRIVATE SECTOR CONTRIBUTIONS BUT DOES NOT INCLUDE PRIVATE SECTOR CONTRIBUTIONS

To summarize, the Consortium is in favor of an increased participation of the private sector in the funding of research in Canada. However, it would be extremely dangerous to expect the private sector to undertake, to any substantial degree, in the short-term, what is the primary responsibility of the federal government, namely the support of a healthy, vibrant academic research community. It is the future of our country which is at stake.

RECOMMENDATION

We therefore urge the Federal Government that a decision be made on the Five-Year Plans submitted in the Fall of 1985. We also recommend that, as a strict minimum, the base budgets of the granting councils be adjusted for inflation in 1986-87 and thereafter.

Question 1 c: How can we foster better linkage between the private sector and universities?

The Consortium is a unique forum to exchange views with the scientific community in Canada. On April 2, 1986, we invited Mr Roberto Gualtieri, as representative of MOSST, to exhange views on the new Matching Programme. This fundamental step was followed by written communications between MOSST and many member organizations of the Consortium. Various workable schemes of implementation have been put forward, in a trial to optimize the impact of the programme. The Consortium already committed itself to take part in the consultation process that will take place after the release of the draft regulation by Finance Department.

In addition to the respective Presidents of the granting councils, the Consortium intends to invite the President of the Science Council of Canada as well as members of the Business community to take part to coming meetings.

Question 3: How could Canada contribute expertise to international development and cooperation?

The Benefits Canada Gains from International Students (International Students and Canadian Foreign Policy, A Brief presented by the Canadian Bureau for International Education to the Joint Committee on Canada's International Relations, November, 1985)

Canada derives considerable benefits from the presence of international students. First, they are obliged by law to bring with them sufficient funds to cover all of their costs while in Canada, an amount which ranges from $7 000 to $15 000. per year per student, depending on the province of study. With a population of 50 000 to 55 000 international students, the gross inflow is at least $500 million. They also pay property and sales tax.

Second, there are clear academic benefits. According to Gordon MacNabb, then president of NSERC, "graduate training in some key disciplines has only survived during the past decade as a result of an influx of visa students". He goes on to say that "in some academic areas there is a shortage of qualified Canadian students willing to undertake graduate study...This lack of Canadian candidates jeopardizes the future of advanced research in these areas. Thus, the availability of visa students to pursue graduate work in these areas helps to maintain the strenght of the research enterprise on which...industrial development depends".

Finally, international educational exchange is an essential part of friendly relations among countries. Students abroad develop a familiarity with their host society and with its subtleties, through working contacts and personal relationships with classmates, researchers, professionals and the business world. When the students return home, these acquaintances may serve as essential links in the flow of ideas, information and technology, leading to stronger cultural and commercial links.

Unfortulately, current trends in our treatment of international students send the message that Canada is not interested in fostering these benefits. A lack of clear policy, limited scholarship assistance, huge variations in tuition fees, program restrictions, enrolment quotas, overseas recruitment practices by so-called "visa schools", restrictions on employment, and a disturbing lack of information about international students and of support services (including health care), do nothing to attenuate this impression. Nor does the recently proposed cost-recovery charge for processing immigration documents, which will impose a handicap on international students, especially those from countries which have limited access to foreign exchange. Canada is pursuing a course increasingly at odds with our own best interests.

RECOMMENDATION

The Consortium recommends that Canada develop a clear, coherent and long-range policy towards international students. The Special Joint Committe on Canada's International Relations should hold hearings on this important issue. In addition, this question of international students should be on the agenda of the First Ministers' meeting on higher education requested above by the Consortium.

Question 9: What can we do to help Canadians deal with the dramatic sweeping changes in all aspects of life which technological change will confront us with the next two decades?

We could not emphasize enough the importance of public awareness of R & D as the cornerstone of the implementation of our national policy on R & D.

We believe that the Science Council of Canada has a crucial role to play with that respect, a role that it has already undertaken with the very limited means at its disposal. The Council is the only body that can elaborate in a comprehensive on objective manner the integration of research in Canada and that can document it. Its work is valued by the Canadian public and by the scientific community which is now aware of its strategical importance for the future of our country.

The scientists also have an important role to play in public awareness of their respective research and of their pertinence for the future of Canada. This is the main reason for the regular annual meetings organized by the Consortium with canadian parliamentarians. In addition, representatives of the Consortium did appear before the Standing Committee of the House of Commons on Research, Science and Technology, on May 28, 1986, to express their views about the mandate of the Committee and the federal policies on R & D.

There is <u>no popular national science magazine</u> available to Canadian public, making the promotion of the public awareness of science most difficult. Aware of this serious handicap, the Consortium recently called upon its member organizations to support the initiative of the Association for the Advancement of Science in Canada (AASC) in that matter. We would invite the other organizations as well as the government to participate to this joint effort and to get in touch with AASC for details.

DOCUMENT: 830-220/029

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

L'élaboration d'une politique nationale des sciences et de la technologie: la participation de la communauté scientifique

Le Consortium National des sociétés scientifiques et pédagogiques

le 8-10 juin 1986
Winnipeg (Manitoba)

The National Consortium
of Scientific and Educational Societies

Le Consortium National
des sociétés scientifiques et pédagogiques

1001-75 Albert, Ottawa, Ontario K1P 5E7 Tel.: (613) 237-6885

L'élaboration d'une politique nationale des sciences et de la technologie: la participation de la communauté scientifique

Bref soumis par

Le Consortium national des sociétés scientifiques et pédagogiques

au

Ministre d'Etat aux sciences et à la technologie

à l'occasion de la

Conférence canadienne sur la politique nationale des sciences et de la technologie

Winnipeg, 8-10 juin 1986

Le Consortium national des sociétés scientifiques et pédagogiques (CNSSP) tient à féliciter les ministres fédéral, provinciaux et territoriaux, des sciences et de la technologie d'avoir pris l'initiative d'organiser la "Conférence canadienne sur la politique nationale des sciences et de la technologie". Nous sommes heureux de participer à cet événement historique qui, nous l'espérons, donnera enfin le coup d'envoi de la politique nationale canadienne en matière de recherche et développement (R & D).

Le Consortium regroupe 30 organismes représentant près de 55 000 chercheurs et professeurs d'universités, de même que 400 000 étudiants regroupés sous l'égide de la Fédération canadienne des étudiants. Le Consortium existe depuis 1976, et il se veut d'abord et avant tout un forum d'échange d'information au sein de la communauté scientifique et étudiante quant aux politiques canadiennes en matière de recherche, de développement et d'éducation post-secondaire. Les organismes suivants sont membres du Consortium national des sociétés scientifiques et pédagogiques:

- Association pour l'avancement des sciences au Canada
- Association canadienne-française pour l'avancement des sciences
- Association universitaire canadienne d'études nordiques
- Association des universités et collèges du Canada
- Conseil canadien de biologie
- Association canadienne des écoles d'études supérieures
- Association canadienne des physiciens
- Association canadienne du personnel administratif universitaire
- Association canadienne des administrateurs de recherche universitaire
- Association canadienne des professeurs d'université
- Bureau canadien de l'éducation internationale
- Conseil canadien des directeurs de départements de biologie
- Federation canadienne des études humaines
- Fédération canadienne des étudiants
- Conseil géoscientifique canadien
- Institut canadien de science et technologie alimentaires
- Association médicale canadienne
- Société canadienne de physiologie
- Société canadienne de recherche clinique
- Association canadienne de microbiologistes
- Société canadienne pour l'étude de l'éducation
- Société canadienne des travailleurs de l'éducation
- Canadiens pour la recherche sur la santé
- Institut canadien de chimie
- Conseil canadien des directeurs de départements de chimie

- Institut des ingénieurs en électricité et en électronique-région canadienne (statut d'observateur)
- Institut professionnel de la Fonction publique du Canada
- Conseil des sciences du Canada
- Fédération canadienne des sciences sociales
- Fédération canadienne des sociétés de biologie

Question 1 a: Le Canada retire-t-il le maximum d'avantages des fonds consacrés à la recherche universitaire? Dans la négative, quelles mesures pourrait-on prendre pour améliorer la situation?

Non, parce que la partie de ces fonds alloués au titre de paiements de transfer à l'éducation post-secondaire, en vertu de la Loi sur le financement des programmes établis (FPE), n'est pas entièrement utilisée à cette fin. Ces argents servent à défrayer les soi-disant coûts indirects de la recherche, comprenant les locaux, les installations et les traitements. De plus, le gouvernement fédéral annonçait récemment des réductions unilatérales du FPE s'élevant à un total cumulatif de $5,5 milliards d'ici 1990. Pour l'année fiscale 1986-87, ces coupures équivalent à $102,4 millions de plus dans les coffres du fédéral qui n'a cru bon d'augmenter les budgets des trois conseils subventionnaires que de $25 millions, alors que $258,1 millions supplémentaires seraient nécessaires pour financer pleinement les initiatives des Conseils, tel que proposé dans leurs plans quinquennaux. A la suite de compressions successives imposées par les deux parliers de gouvernement, le système universitaire canadien est au bord du désastre, puisque depuis 1977-78, les effectifs dans les universités ont augmenté de 24% alors que les dépenses réelles par étudiant en dollar constant, ont diminué de 18%.

RECOMMANDATION

Pour éviter que les gestes du gouvernement fédéral incitent les provinces à réduire davantage leur appui financier aux universités, le fédéral ne devrait pas mettre en pratique les modifications proposées au FPE (Bill C-96). Il faudrait plutôt convoquer une réunion des premiers ministres pour trouver une solution aux problèmes de l'enseignement post-secondaire au Canada.

RECOMMANDATION

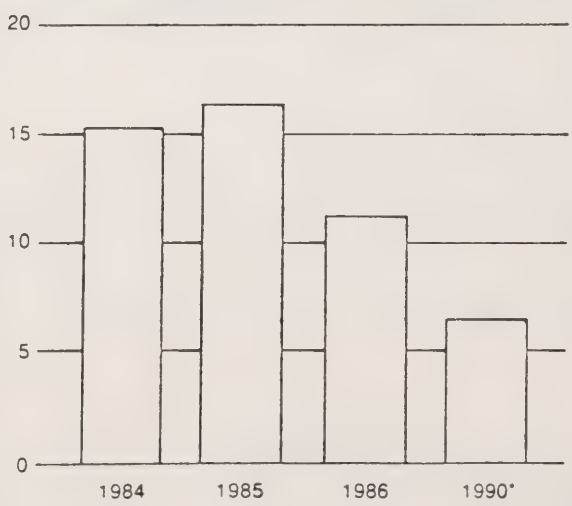
Vu que la recherche fondamentale effectuée presqu'exclusivement dans nos universités est, et devrait être une priorité fédérale, le Consortium recommande que le nouveau Comité permanent de la Chambre des Communes sur la recherche la science et la technologie se penche, non seulement sur les coûts directs de la recherche, mais également sur les coûts indirects et sur toute autre question relative à l'éducation post-secondaire ayant une influence directe et indirecte sur la recherche universitaire.

Question 1 b: Si de nouveaux fonds devenaient disponibles, devrait-ils être utilisés pour la recherche universitaire?

Oui, dans la mesure où les universités (i)"sont les chefs de file dans le domaine de la recherche fondamentale et (ii) qu'elles restent la principale source où une société dynamique puise ses spécialistes" (David G. Vice, Président, Northern Telecom Ltd, Les moyens de notre avenir, MEST, 1986, pp. 9-10), et qu'à moins d'atteindre une masse critique d'investissement en recherche fondamentale (R), le Canada ne pourra concrétiser le développement (D) de son immense potentiel.

Au Canada, les coûts directs de la recherche universitaire sont presqu'entièrement supportés par les trois Conseils de recherche fédéraux, moins de 1% des dépenses totales des universités étant supportées par le secteur privé (Les moyens de notre avenir, MEST, 1986). De plus, une étude publiée en février 1986 par le Conference Board of Canada démontrait clairement que les intentions d'investissement en R & D au sein de corporations canadiennes seraient à la baisse en 1986, et que cette tendance irait en s'amplifiant d'ici 1990, tel que démontré sur la figure suivante. C'est à la lumière de ces faits que nous aimerions brosser le bilan du plan de financement des agences subventionnaires que le gouvernement fédéral déposait en février dernier.

Chart 2
R and D Spending Intentions, All Respondents



*Average annual compound rate of growth from 1986 to 1990.

Source: The Conference Board of Canada.

Bilan de financement des agences subventionnaires déposé en février 198[illegible]

Premièrement, nous considérons comme positif, bien qu'insuffisant, l'engagement du Gouvernement fédéral de garantir pour les cinq années à venir l'équivalent du budget total accordé en 1985-86 à chacun des Conseils.

Deuxièmement, les augmentations respectives de 4%, 4% et 10% originellement annoncées par le CRM, le CRSNG et le CRSH étaient considérées comme un pas dans la bonne direction. Toutefois, après une seconde analyse, il semble que les augmentations ne soient plus que de 2% au CRM, suite à l'imposition de la coupure budgétaire de 2% imposée au Ministère de la Santé et du Bien-Etre, coupure qui, selon nos informations, ne devait pas s'appliquer aux projets de recherche du CRM; pour sa part le CRSNG s'est vu imposer un gel non prévu de son budget de l'ordre de $3.6 millions pour une période de deux(2) ans, afin de défrayer une partie d'un programme de $6 millions ordinairement facturé au Service des Forêts du Canada. Il s'agit là d'une pratique inacceptable qui, en plus de causer une diminution effective des augmentations budgétaires accordées en 1986-87 au CRSNG de 4% à 2.8%, rend impossible la planification des activités des Conseils et qui plus est, induisent la population canadienne en erreur quant aux montants réellement alloués à la R & D dans ces secteurs.

Troisièmement, nous voudrions exprimer les réserves suivantes quant au plan de financement. D'une part, les sommes annoncées étant exprimées en dollar courant, aucune provision n'a été faite pour couvrir les coûts inflationnaires qui devraient s'établir à environ 4%. D'autre part, selon le plan de financement actuel, toute croissance budgétaire des Conseils repose uniquement sur l'appariement par le Gouvernement fédéral des contributions faites par le secteur privé. L'étude du Conference Board of Canada citée plus haut démontre clairement que les intentions d'investissement en R & D par les corporations (moins de 1% de la recherche universitaire) sont à la baisse. De plus, bien que le Ministère des Finances n'ait pas encore rendu publiques les règles finales qui régiront ledit programme, les informations contenues dans le budget de février 1986 laissent présager des problèmes d'ordre conceptuel qui risquent fort de rendre difficile l'application du programme et d'invalider ses objectifs.

A ce point-ci, je désire porter à votre attention le cas patent des sciences sociales et des humanités qui sont actuellement spécifiquement exclues de la définition de la recherche scientifique aux termes de la Loi de l'impôt sur le revenu. Même si cette exclusion était éliminée, il est peu probable que l'entreprise privée soutienne la recherche en sciences sociales à un niveau proportionnellement comparable aux sciences naturelles. A un dégré moindre, les recherches médicales font face au même problème, puisque la seule source substantielle de fonds privés est l'industrie pharmaceutique qui investit de moins en moins dans la R & D au Canada. Dans les deux cas, il serait primordial que soit adoptée une définition large plutôt que littérale du secteur privé.

Quatrièmement, le Consortium national des sociétés scientifiques et pédagogiques est extrêment désappointé que les plans quinquennaux réalistes et méticuleusement préparés par chacune des agences subventionnaires semblent avoir été relégués aux oubliettes par le gouvernement. Le support unanime de la communauté scientifique pour ces plans et la performance remarquable des agences subventionnaires quant à la gestion des fonds publics et à la qualité de la recherche effectuée sous leur supervision étaient et sont toujours nos meilleures garanties qu'un investissement accru du Gouvernement fédéral dans la R & D est un risque calculé, planifié. En l'absence de plan quinquennaux, il est difficile de concevoir comment nos objectifs nationaux en matière de R & D seront poursuivis à long terme.

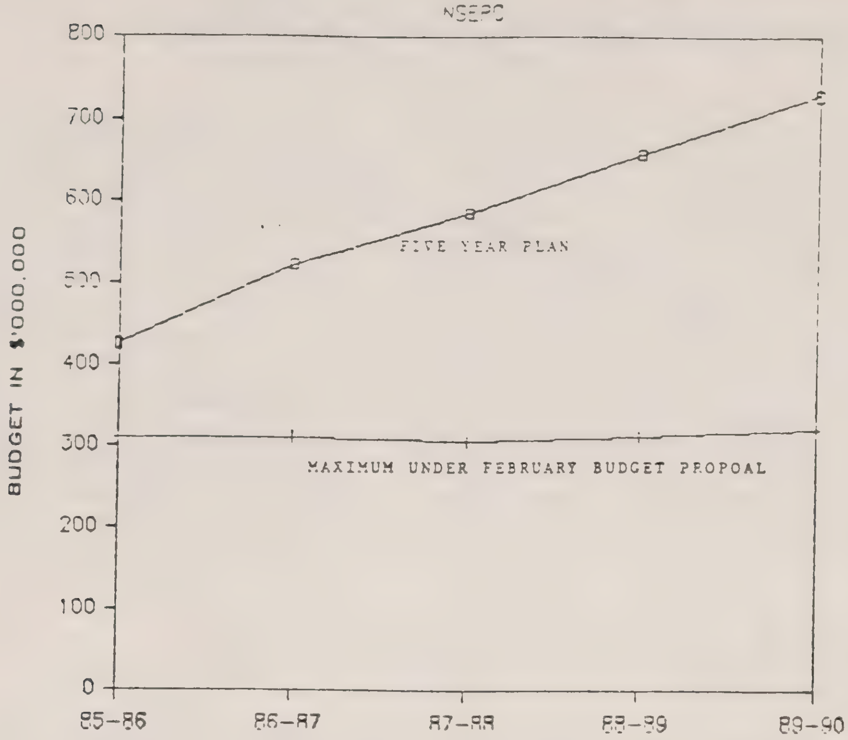
Les diagrammes suivants démontrent clairement une divergence croissante entre les budgets proposés dans les plans quinquennaux et le financement maximum possible selon les propositions budgétaires de février 1986. Bien que les subventions fédérales d'appariement aient été utilisées pour calculer le scénario optimal, la contribution du secteur privé n'a pas été incluse à escient, puisque ces argents ne seront pas disponibles pour supporter les activités de base des Conseils, mais devront plutôt être alloués à des contrats de recherches spécifiques.

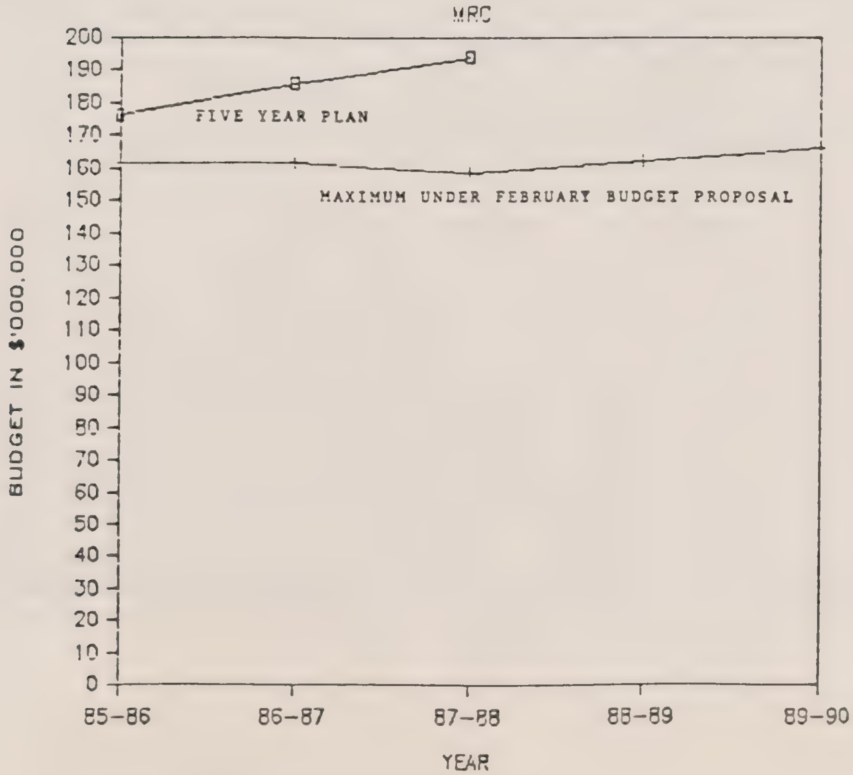
En conclusion, bien que le Consortium croit nécessaire une participation accrue du secteur privé au financement de la recherche au Canada, nous pensons qu'il serait catastrophique pourla recherche universitaire et pour l'avenir de notre pays,de surestimer la capacité du secteur privé de prendre à sa charge, à court terme, une partie significative de la responsabilité du Gouvernement fédéral comme principal supporteur de la R & D au Canada.

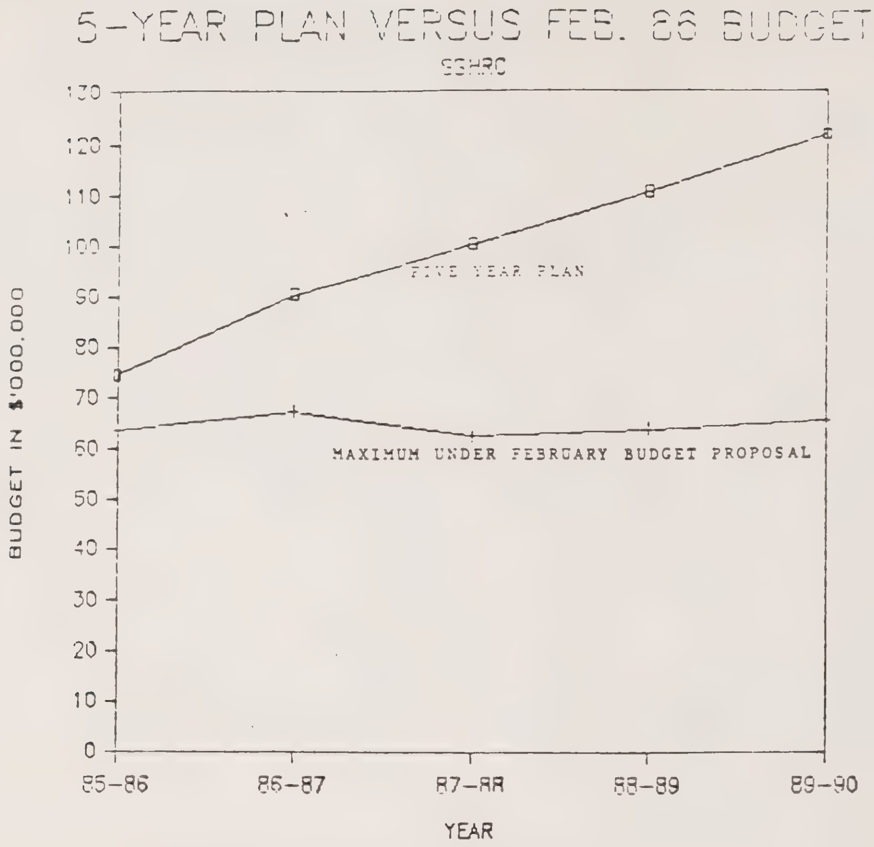
RECOMMANDATION

En conséquence, nous demandons au gouvernement qu'il statue sur l'adoption ou le rejet des plans quinquennaux tels que soumis au Cabinet à l'automne 1985. Nous recommandons également que le budget de base des agences subventionnaires soit au minimum indexé pour l'inflation en 1986-87 et pour les années subséquentes.

5-YEAR PLAN VERSUS FEB. 86 BUDGET







ALL FIGURES IN CONSTANT 1985-86 DOLLARS
INFLATION ASSUMED TO BE 4% PER YEAR

MAXIMUM MEANS APPROVED BUDGETS PLUS BUDGET INCREASES PLUS FULL FEDERAL MATCHING OF PRIVATE SECTOR CONTRIBUTIONS BUT DOES NOT INCLUDE PRIVATE SECTOR CONTRIBUTIONS

Question 1 c: Comment pouvons-nous favoriser l'établissement de meilleurs liens entre le secteur privé et les universités?

Le Consortium est un organisme de consultation de la communauté scientifique unique en son genre au Canada. Le 2 avril 1986, le Consortium ouvrait ses portes au représentant du MEST, M. Roberto Gualtieri, afin de discuter de la mise en place du nouveau programme d'appariement. Cette étape fondamentale fut suivie de communications écrites entre le MEST et plusieurs organismes membres du Consortium, qui ont utilisé leur expertise du milieu pour suggérer des scénarios susceptibles d'améliorer les chances de succès du programme. Le Consortium s'est également engagé à participer activement à la consultation qui suivra la publication des règles directrices du programme par le ministère des Finances.

En plus des présidents des Agences subventionnaires fédérales, le Consortium compte inviter le président du Conseil des Sciences du Canada, de même que des membres influents du secteur des affaires, lors de rencontres à venir.

Question 3: Comment le Canada pourrait-il mettre les compétences canadiennes au service du développement et de la collaboration à l'échelle internationale?

La présence d'étudiants étrangers: un avantage pour le Canada (La politique canadienne et les étrangers, mémoire présenté par le Bureau canadien de l'éducation internationale au Comité mixte sur les relations extérieures du Cnada, novembre 1985).

Le Canada retire d'innombrables avantages de la présence d'étudiants étrangers sur son territoire. Premièrement, la loi exige que ces derniers aient suffisamment de fonds pour couvrir toutes leurs dépenses pendant leur séjour au Canada, montants qui oscillent entre $7 000. et $15 000. par année selon la province dans laquelle ils ont choisi de poursuivre leurs études, Si l'on estime qu'il y a 50 000 à 55 000 étudiants étrangers au Canada, la rentrée brute d'argent équivaut à non moins de $500 millions. Ajoutons que ces étudiants payent également des impôts fonciers et de la taxe de vente.

Deuxièmement, les avantages sont incontestables du point de vue académique. M. Gordon MacNabb, alors président du Conseil de recherches en sciences naturelles et en génie du Canada, affirmait: "si les programmes d'études supérieures dans certaines disciplines-clé ont survécu au cours de la dernière décennie, c'est grâce aux étudiants étrangers". Il poursuivait en affirmant que "certaines branches souffrent d'une pénurie d'étudiants canadiens prêts à entreprendre des études supérieures...mettant en jeu l'avenir de la recherche de pointe dans ces domaines. Aussi, les étudiants étrangers qui entreprennent des études dans ces secteurs permettent-ils de maintenir un niveau de recherche indispensable à la croissance industrielle."

Finalement, l'éducation internationale constitue un élément essentiel des relations amicales entre pays. Les étudiants à l'étranger ont l'occasion de se familiariser avec les normes et les nuances de la société du pays hôte grâce aux contacts professionnels et aux relations qu'ils nouent avec leurs confrères de classe, les chercheurs, les professionnels et les hommes d'affaires. De retour au pays natal, ce réseau de connaissances peut leur servir de maillon vital dans l'échange d'idées,d'information et de technologie, renforçant ainsi les liens culturels et commerciaux.

Or, notre façon de traiter les étudiants étrangers à l'heure actuelle laisse croire que le Canada n'est pas intéressé à mettre en valeur ces avantages. L'absence d'une politique précise, une aide financière limitée, les immenses écarts des frais de scolarité, les restrictions d'emploi et le manque troublant d'informations sur les étudiants étrangers et des services de soutien (y compris les soins de la santé), ne viennent en rien atténuer cette impression. D'ailleurs la situation n'est guère favorisée par la récente proposition d'exiger des frais dits de "récupération des coûts" pour le traitement des documents de l'immigration. Il s'agit là d'un sérieux handicap, plus particulièrement pour ceux venant de pays dont les réserves de devises sont limités. Le Canada semble s'engager dans une voie qui va de plus en plus à l'encontre de ses propres intérêts.

RECOMMANDATION

Le Consortium recommande que le Canada mette au point une politique à long terme, claire et cohérente, relative aux étudiants étrangers. Le Comité mixte spécial sur les relations extérieures du Canada devrait tenir des audiences publiques sur cette question , qui devrait également être à l'ordre du jour de la réunion sur l'enseignement post-secondaire des premiers ministres recommandée plus haut par le Consortium.

Question 9: Que pouvons-nous faire pour aider les Canadiens à faire face aux changements radicaux dans tous les aspects de la vie que provoquera la technologie au cours des deux prochaines décennies?

La sensibilisation du public à l'égard de la R & D est la pierre d'achoppement de l'implantation de la politique nationale de la R & D sur laquelle nous ne saurions trop mettre d'emphase.

Nous pensons que le Conseil des Sciences du Canada a un rôle essentiel à jouer à cet égard, rôle qu'il a d'ailleurs fort bien su assumer à ce jour, malgré des moyens trop limités qui sont à sa disposition. Le Conseil est le seul organismes qui puisse discuter de façon intelligente et objective de l'intégration de la recherche au Canada, documents à l'appui. Il jouit également d'une excellente crédibilité auprès du public canadien, dont les membres de la communauté scientifique qui sont désormais conscients de son importance stratégique pour l'avenir de notre pays.

Les scientifiques ont également un rôle à jouer, afin de sensibiliser le public à l'importance de leurs recherches respectives et à leur pertinence pour l'avenir du pays.C'est d'ailleurs là la raison principale des visites annuelles qu'effectuent les représentants du Consortium auprès des parlementaires canadiens. De plus, les représentants du Consortium comparaissaient, le 28 mai dernier, devant le Comité permanent de la Chambre des Communes sur la recherche, la science et la technologie, afin de faire part de leurs vues sur le mandat du Comité et sur les politiques fédérales en matière de R & D,

L'absence d'un magazine scientifique national accessible au public canadien est toutefois un problème qu'il nous faudra résoudre si nous voulons atteindre notre objectif: la sensibilisation du public. Conscient de ce sérieux handicap, le Consortium faisait récemment appel à ses organisations membres afin de supporter financièrement une initiative valable de l'Association pour l'Avancement des sciences au Canada (AASC) en ce domaine. Nous voudrions encourager les autres organismes et le gouvernement à contribuer à cet effort collectif en contactant l'AASC au plus tôt.

DOCUMENT: 830-220/030

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Pulp and Paper Research Institute of Canada

June 8-10, 1986
Winnipeg, Manitoba

PLEASE NOTE

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Peter E. Wrist

Pulp and Paper Research Institute of Canada

Paprican believes that a National Policy for Science and Technology is needed

a). to provide direction, continuity and cohesiveness to the Government's programmes in support of these important areas.

b). to improve the public's understanding of the issues involved and the importance of the role that science and technology must play in the future economic health of the Canadian economy,

c). to provide the guidelines and a framework within which coherent, stable programmes of cooperation between governments universities and industry can be nurtured and sustained.

Such a policy should build upon the special strengths of Canada and should avoid encouragement of competition in every possible field of science or technology. It should also take into account the diverse and geographically widespread nature of the country, turning these characteristics into advantages rather than liabilities. Canada has no unique advantages over other countries in the development of new High Technologies but it does

have special opportunities in which to seek competitive [illegible] in their application. Examples include communications, transmission of electric power and transportation over long distances. Canada also has large natural resources in which application of High Technology will be needed in the future if these national assets, on which a large number of remote communities totally depend for their livelihood, are to remain competitive in world markets.

There is vital distinction between the generation of new knowledge and the the process of industrial innovation which the background paper fails to clarify. The implication throughout the paper appears to be that the progression from new knowledge to successful innovation is a direct and linear one. This is far from the case in real life although there are very important interactions between the two enterprises. Their distinctions must be kept clearly in mind when we consider the desirable goal of increased interaction between industry and universities on which the paper places strong emphasis. The scientist seeks new knowledge at the edge of existing knowledge. The innovator seeks to exploit the opportunity of providing a commercial solution to an existing or perceived need. He does so with the aid of existing knowledge whenever possible. It is only when the

innovator lacks the knowledge to achieve his [illegible] turns to the scientist for help or when the scientist [illegible] that his new understanding provides an hitherto unavailable [illegible] solution to an identified need that he seeks out or himself becomes the innovator. The interface between scientist and innovator should then be face to face. The most effective role for government to play in this relationship is to encourage the direct personal contact between the two and the worst thing it can do is to attempt to become the information broker, setting up bureaucratic agencies to play the role of intermediator.

The experience of Paprican is a [illegible] useful role model in this regard. By participating directly [illegible] in the training of graduate scientists and engineers it contributes directly to the creation of new knowledge. By carrying out sponsored research and development for, and in close consultation with, the forest products industry, it is closely in touch with the current market needs and future opportunities. The interaction between scientist and innovator takes place naturally on a very frequent basis. Maintaining a good relationship between Paprican and the universities and between Paprican and the industry it serves requires continuous effort and takes a long time to develop. As a founding partner of Paprican the Government of Canada has provided encouragement and support without imposing itself

obtrusively at either the university or the industry interface. At the same time the industry has borne an increasing responsibility for the financial support and for the direction of the research effort.

The equipment manufacturers and process designers play an important role in the successful introduction of new technologies. This is an segment of our industrial base that has been neglected in recent years, at least so far as the forest products industries are concerned. The suppliers of this equipment to our industry today are largely offshore, or in other cases, subsidiary manufacturing facilities of companies which conduct their innovative engineering and development work at their foreign headquarters. Consideration should be given in a national policy to steps that will encourage such companies to carry out some of their development in Canada, since this would not only increase the viability of the Canadian subsidiaries but it would also facilitate their interaction with Canadian universities and other research centres. At present it is not unusual for the results of Canadian research to be picked up by equipment manufacturers in other countries and then imported back to Canada in the form of equipment for use in Canadian mills.

CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

Peter E. Wrist

Institut canadien de recherches sur les pâtes et papiers

Paprican est d'avis qu'une politique nationale des sciences et de la technologie doit être mise en oeuvre pour :

a) orienter et harmoniser les programmes gouvernementaux destinés à ces secteurs clés et en assurer la constance;

b) sensibiliser davantage le public à ces dossiers et au rôle de premier plan que les sciences et la technologie joueront dans l'avenir économi ue du Canada;

c) établir des lignes directrices et un cadre réglementaire favorisant la mise en oeuvre et le maintien de programmes de coopération entre les gouvernements, les universités et l'industrie.

Cette politique devrait s'appuyer sur les points forts du Canada, sans chercher à s'attaquer à tous les domaines des sciences et de la technologie. Elle devrait également tenir compte de la diversité et de l'étendue du pays, et faire en sorte que

l'on tire pleinement profit de ces caractéristiques. Si le Canada n'a pas d'avantage particulier sur les autres pays en matière de développement des technologies de pointe, il a cependant la possibilité de se distinguer quant à leur application. Les communications, le transport de l'électricité et le transport sur de longues distances en sont d'excellents exemples. Le Canada dispose par ailleurs d'importantes ressources naturelles; il devra nécessairement recourir à la haute technologie pour faire en sorte que ces matières premières, dont l'exploitation constitue l'unique moyen de subsistance d'un grand nombre de collectivités éloignées, conservent leur avantage concurrentiel sur les marchés internationaux.

Le document de travail du MEST laisse dans l'ombre la différence fondamentale qui existe entre le développement de nouvelles connaissances et le processus d'innovation industrielle. Il suggère au contraire que l'innovation découle tout naturellement de l'acquisition de connaissances nouvelles. Malgré l'interdépendance de ces deux activités, rien n'est plus loin de la vérité. Si une collaboration accrue entre le secteur privé et les universités est certes souhaitable, comme le souligne abondamment le document de travail, il faut cependant garder à l'esprit cette distinction essentielle entre leurs activités respectives. Le scientifique tente de faire reculer les frontières du savoir. L'entrepreneur cherche quant à lui à apporter une

solution commerciale à un besoin réel ou futur : pour ce faire, il recourt, dans la mesure du possible, aux connaissances existantes. Ce n'est que lorsque les connaissances lui font défaut que l'entrepreneur se tourne vers le scientifique; et ce n'est que lorsque le scientifique s'aperçoit que le résultat de ses recherches constitue une solution à un besoin réel qu'il fait appel à un entrepreneur ou qu'il le devient lui-même. Il ne devrait pas y avoir d'intermédiaire entre le scientifique et l'entrepreneur. La meilleure façon de jouer son rôle serait pour le gouvernement d'encourager les contacts directs entre les deux intervenants; la pire façon serait de s'imposer comme un " courtier en information " et de mettre sur pied des organismes chargés d'agir comme intermédiaires.

A cet égard, Paprican est un exemple à suivre. En participant directement à la formation des diplômés en sciences et en génie, il contribue au développement de nouvelles connaissances. En effectuant de la R-D pour le compte de l'industrie forestière et en étroite collaboration avec elle, il se tient au fait des besoins du marché et des débouchés virtuels. Le scientifique et l'entrepreneur sont donc appelés à collaborer régulièrement. Le maintien d'une bonne relation entre Paprican et les universités, et entre Paprican et l'industrie dont il est le porte-parole, nécessite un effort soutenu. En sa qualité de cofondateur de Paprican, le gouvernement fédéral lui a accordé son

appui sans s'imposer auprès des universités ni de l'industrie. Parallèlement, l'industrie s'est intéressée de plus en plus à l'orientation des travaux de recherche et a augmenté son soutien financier en conséquence.

Les fabricants de matériel et les concepteurs industriels jouent un rôle de premier plan dans l'application fructueuse des nouvelles technologies. Or ce secteur de notre industrie a été grandement négligé au cours des dernières années, du moins en ce qui a trait aux produits forestiers. Les fournisseurs de ce matériel sont, en grande partie, des entreprises étrangères; ou alors il s'agit de filiales de sociétés qui effectuent leurs travaux de R-D à leur siège social situé à l'étranger. La politique nationale devrait prévoir des mesures incitant ces entreprises à développer leurs produits au Canada, ce qui non seulement accroîtrait la viabilité de leurs filiales, mais faciliterait leur collaboration avec les universités et les centres de recherche du pays. A l'heure actuelle, il n'est pas rare que des fabricants étrangers mettent à profit les travaux de chercheurs canadiens pour ensuite vendre le matériel ainsi produit aux usines de papeterie canadiennes.

Viewpoint

Encouraging Technology Transfer

by Dr. Paul E. Gray

The university has traditionally been one of the primary sources of creative thought in society. Another newer locus is found in the Federal laboratories. As all of us in the field of technology are aware, however, creative thought does not in itself ensure the transfer of discoveries and inventions to society in a meaningful way. It is therefore essential that we develop cooperative activities between basic research institutions and industry that will assure both the rapid and effective transfer of new technologies, the relevance of our education programs, and the necessary financial support of the underlying research.

With the passing of time, my convictions about these issues have only become stronger. Over the past few years, intensified international competition and the increasing pace of technical developments in many fields have brought about a heightened interest on the part of industry in university research activities. Experience has shown that these interactions not only strengthen the industries involved, but they also enrich both the research effort on our campuses and the quality of our teaching.

Our experience at MIT is that the technology transfer occurs spontaneously at the level of individuals, at the level of people meeting, talking and working with people. Government supported centers and boards chartered to "program" technology transfer as if by magic probably would not have a major impact. Programs to create local environments—at universities, at national laboratories—where interactions can take place would, in my view, be the most significant contribution the Federal government could make to the cause of technology transfer.

The NSF, by the way, has already begun such efforts by providing support for the establishment of university centers devoted to specific areas of technology—at MIT it is applied biotechnology—where programs will, by design, involve both representatives from relevant companies and university personnel. The new NSF program came out, in part, from an earlier NSF-supported experiment conducted at MIT. In the early 1970s, with NSF support, we established at MIT a university-industry program of research in polymer processing. The companies that joined with us in that effort became enthusiastic about the benefits they derived from the association—so much so that the private sector took over the financing within a few years and the NSF support was terminated.

In other words, it has been shown increasingly that personal ties between basic research workers and industry representatives will streamline the identification and exploitation of technical advances derived from basic research and applied to the marketplace. The innovation that begins in a basic research laboratory usually must be nurtured and developed before it can lead to commercially important products or services. To speed this process, business and universities—and, perhaps, Federal laboratories—must work together and communicate effectively with one another at the personal level.

All this industry-university action, by the way, has not, for some reason, won widespread popular approval in this country, judging by the press. Despite mounting evidence of the value of university-industry cooperation, there remains within our society the vague suspicion that industrial interactions somehow taint the groves of academe, that the purity of scholarship is somehow corrupted by association with business.

In my view, such mistrust as may exist probably stems from the belief that the needs of industrial partners for proprietary secrecy and other competitive advantages necessarily run counter to and may undermine academic traditions of open scientific exchange. MIT has had as much experience with industrial cooperation over as long a period of time as any major institution in the United States. From that vantage, I can tell you that if university-industry interactions are negotiated carefully, thoughtfully, and in good faith, the interests of the public, industry and academia can be—and are being—protected.

Dangers do exist and our experiences at MIT have shown that the incentives for both parties must, from the outset of negotiations, be clarified and assessed, for they are the key to the evolution of a strong and healthy partnership. That mutually beneficial and protective agreements can be arrived at is now clear and we need harbor no fears that industry-university interactions, *ipso facto*, work to the disadvantage of the university or the public.

Photo: Jim Harr

Paul Gray, President of MIT

Of all the various linkages between MIT and industry, it is fair to say that the most complex—and therefore the most difficult—has been sponsorship of research by corporations. The difficulty arises largely from some of the different characteristics of industrial research and of academic research. Efforts have sometimes foundered because of the conflicting roles seen by the participants.

There are, I believe, four primary barriers to productive university-industry relationships. First is the difficulty of designing a collaborative research program that fits the university's educational obligations toward its students and the industry partner's concern for useful knowledge to be applied toward development of products, processes, and services. Second is how to organize a research program that accommodates the time constants of universities, where graduate students intimately involved with the research are following programs of stu-

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VIEWPOINT
(continued from page 3)

that span several years, and industry's time constants, which tend to be oriented to fast-moving markets. Third, is how to protect proprietary information supplied by a sponsor to facilitate a research program — so university scientists do not unknowingly try to re-invent existing technology — while meeting the statutory and ethical requirements that university research serve a broad public good and be conducted in an atmosphere of openness and free exchange. Fourth relates to patents and copyrights — how to determine methods of licensing that will promote the progress of science and technology, that will assure that discoveries and inventions are used in ways that benefit the public, and that provide recognition for university inventors and financial support for their universities.

The MIT experience suggests that with careful planning, each of these issues can be resolved and the needs of each research partner — and the public — can be met without conflict or compromise.

The most obvious national advantage to fostering wider university-industry relations — or relations between Federal laboratories and industry — is clearly the quicker and more effective application of the fruits of research to industrial operations. If there is no national interest to be solved by this kind of industry-university cooperation, such joint efforts cannot and will not long survive. But there is a national interest. Germany and Japan have not often seized from us positions of scientific leadership; but have often succeeded in superior implementation. Thus stronger relationships that bridge between industry and basic research can be seen as matters of national interest to be encouraged and fostered by Congress.

There is an intellectual incentive, also — one not often mentioned in discussions of university-industry relations. Linkage with industry can give our basic research programs new perspectives. While universities and Federal laboratories continue to move in directions governed primarily by the shifting frontiers of knowledge and by the instincts and insights of their faculties and staff scientists, the universities and laboratories benefit from the perspectives that can be gained from close associations with industry. Conversely, the benefit pays back to industry in the form of research programs more closely geared to industrial interests and in the form of graduates better prepared to meet industrial needs when they take up industrial employment, not to mention the intellectual impacts on the industry representatives themselves.

Overall, to promote productive university-industry interactions, the Federal government must concentrate on creating environments where interactions are fostered, favored, and encouraged, and avoid trying to create institutional frameworks that seek to affect human behavior by means of edict. It won't happen. Rather, we must explore ways in which Federal agencies that already exist and have long experience with the nation's basic research infrastructure can promote industry interaction. Specifically, universities and Federal laboratories should be seeking out commercially interesting work to do that is not hampered by the restraints of secrecy.

This means aggressive programs within universities and Federal laboratories to enlist industrial cooperation and interaction, perhaps even the establishment of offices within these organizations specifically organized to develop industrial liaison. Agencies and universities, likewise, might put forth organized efforts to market patents and copyrights that grow out of basic research and, in that manner, develop contacts with industry. Universities and Federal laboratories also need to find ways to communicate directly with corporate chief executive officers relating to specific high technology areas that are just taking form at the basic research level. I cannot emphasize enough, based on our experiences at MIT, the need to involve basic research organizations with chief executive officers.

Finally, it is my belief that some of the greatest rewards to society from basic research have come from focusing on making major advances, not just on incremental improvements. And I am persuaded by our long experience at MIT that, when the industrial dimension is added to basic research organizations, these major innovations will emerge spontaneously at the person-to-person level. In the final analysis, that's the level where transfer really happens.

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Response to

CHALLENGES AND CHOICES

the interim report

of the Royal Commission

on the Economic Union and Development Prospects for Canada

OCTOBER 1984

5. PRODUCTIVITY

In its initial report, the Royal Commission suggested that technological excellence is essential if Canadian industry is to meet the productivity challenge that is so important to world-wide competitiveness. This section of our submission therefore focuses on one of the keys to improved technology, namely, research and development.

i) Technological Excellence

In general, Canadians have probably tended to underestimate the importance of technology in our resource-based industries. Pulp and paper, in particular, is often perceived to have reached the zenith of its technological development and to lack challenges and opportunities for further advance. New technologies, and high technology, are not perceived to be a part of its makeup.

In reality, close examination of a modern Canadian paper mill reveals that the industry requires and uses very sophisticated process technology. A modern newsprint machine is as large as a three-story house and longer than a football field. It performs a feat that would be impossible without the application of high-technology: converting a dilute slurry of wood fibres, moving at 70 kilometres per hour, into a continuous ribbon of paper 10 metres wide, the entire process being computer-controlled and employing electronic scanning devices to monitor thickness, density, moisture control, and brightness.

We often hear of the need for governments to establish technology development policies and to fund research and technological development programs in microelectronics and biotechnology. Such sectors are indeed important. But they cannot be expected to lead the Canadian economy, and their development should not be pursued at the expense of failing to promote technological advance in our traditional workhorse industries.

ii) Innovation in the Pulp and Paper Industry

The pulp and paper industry is a consumer of new technology and has long been committed to investment in research and development. The industry has learned that success in R & D is not necessarily assured by the expenditure of large sums of money. It also requires the proper identification of needs, the recruiting and supporting of excellent people, and close interaction with potential users.

In 1925 the industry, in conjunction with the Federal Government and McGill University, created the Pulp and Paper Research Institute of Canada (PAPRICAN) to carry on scientific research and to educate technical personnel. Today its annual operating funds ($17.3 million) are furnished by the industry and the capital for buildings and facilities is provided by the Federal Government.

In addition to its collaborative program in graduate education with McGill University, in operation since 1925, the Institute

now has a similar program at the University of British Columbia -- now to be strengthened by the new $6.5 million UBC Pulp and Paper Centre, financed by the B.C. government -- and at École Polytechnique in Montréal. Over the years, more than 500 research scientists have been trained.

No other Canadian industy can point to such a long tradition of strong support for cooperative research and education. PAPRICAN has been responsible for introducing many innovations in the industry. It has, in addition, provided much of the background knowledge necessary for the companies themselves to develop improved processes and products.

In addition to PAPRICAN, many of the companies have their own research laboratories and/or technical staffs to develop new and improved products and to improve productivity and profitability.

The majority of the companies also support the Forest Engineering Research Institute of Canada (FERIC), which is concerned with the technology of wood harvesting and transportation.

The pulp and paper industry does not rely solely on its own research and technical resources for innovation. To keep pace with the ever changing state-of-the-art, companies must be alert to developments by their suppliers and those made elsewhere in the world. Indeed, secondary industry is a very important source of new technology.

The problem in Canada is that the head offices and R & D facilities of most of the major equipment manufacturers are located in other countries. As a result, the Canadian industry imports much of its new equipment. Furthermore, the valuable close working relationships amongst research laboratories, suppliers and users, so common in Scandinavia and the United States, do not exist to the same extent in Canada.

A key ingredient to successful development and commercialization of a promising idea is the involvement of a supplier early in the innovation process -- preferably during the research phase. In Canada, although there have been a number of successful collaborative developments, it is increasingly difficult to find suppliers who are capable and willing to collaborate during the early stages of development. This is a serious deficiency, which handicaps technological innovation.

iii) Ingredients for Technology Development

Canada is the world's second largest pulp and paper producer and is considered by many to be in the forefront of technological innovation. Nevertheless, the availability of our vast softwood forests will not necessarily assure the Canadian industry a dominant place in future world markets. Worldwide technological developments in manufacturing and in the market place are stimulating forest products investment elsewhere in the world.

There is a broad awareness and a growing consensus that Canada must increase its research and development effort to ensure its continued industrial success. The innovation process is not, however, dependent on industry alone. It must include collaboration with universities, and governments. We therefore offer the following suggestions:

1. <u>Government policies should build on the basic strengths of Canada's economy</u>: in particular, those resource-based industries which are equipped to compete with the industries of other countries by reason of our natural resources and our established infrastructure, and which with the addition of high technology, can provide substantial growth in exports. Canada does not have unique or particular advantages in the so-called high-technologies involving microelectronics. But it does with respect to its forests, its hydro-electric power, and its other natural riches.

   As a result, government policies should promote the development and application of advanced technology particularly in the resource based industries, and not merely focus its attention on what are often referred to as the high-technology industries.

2. Over the years, governments have invested large sums of money in industrially-oriented, intramural research -- including unsolicited proposals, feasibility studies, and government laboratories with industrial research missions. However, <u>decisions regarding technology and research are</u>

best made as close as possible to the market place, where the real needs are known and where technology transfer must take place.

Governments should therefore devote more of their resources to stimulating the private sector to become aggressive innovators. The Federal Government has done this very effectively with its support of PAPRICAN and FERIC, and also FORINTEK, which conducts research on wood products and for which a number of the provinces have provided essential funding. More such support should be undertaken.

3. Much government intramural research is generally not perceived as relevant to industry's needs. That perception is often correct; but on the other hand it sometimes happens that government laboratories have not worked hard enough to acquaint industry with the work and its potential significance. In any event, industry should have more input into the development and evaluation of research programs, and into providing advice on technology transfer, particularly in those government laboratories claiming to be working on behalf of an industry or industries. Furthermore, the government should not itself attempt to carry out such a broad spectrum of research programs as at present.

4. It is widely known and understood that industry prefers R & D tax incentives to stimulate increases in the nation's industrial R & D effort. These incentives help to reduce the very high risks involved in technology transfer,

particularly with respect to pilot scale and mill prototype trials. As a result, industry has generally welcomed and supported government initiatives to increase and improve the tax incentives for R & D, since often, little or no return on an R & D investment is realized for a decade or even longer. Governments should leave these incentives in place for at least 10 years, to ensure continuity and consistency in funding.

5. <u>For industry to be competitive and innovative, it needs a good supply of highly qualified personnel</u>: researchers, engineers and a variety of specialists for operations. Governments, both federal and provincial, have a responsibility to maintain and increase, as appropriate, their support of science, engineering and related fields at Canadian universities and colleges.

6. <u>Governments should encourage a much higher level of collaboration between universities and industry</u>. PAPRICAN's collaborative programs with universities have greatly benefitted our industry and have at the same time enhanced the education of young men and women.

7. <u>Research and development cannot be carried out in a vacuum.</u> Industry must be kept aware of new technologies and new products developed in other countries, particularly those that might represent opportunities or competitive threats to Canadian industry. Governments and universities could aid

more effectively in the collection of such world-wide technical intelligence.

8. Although tax incentives may help, as noted earlier in this section, techniques must be found to improve collaboration between equipment suppliers and user industries in the development of new technology. In Scandinavia, in particular, the pulp and paper industry profits from a very effective synergism resulting from the extremely close working relationships between research organizations, equipment manufacturers, and pulp and paper companies. This may result from corporate relationships which exist there. The fact remains that in Canada the desired degree of interaction has not occurred, and a distinctly Canadian solution is probably required. It is very important that equipment suppliers conduct R & D in Canada, so that they are able to collaborate with the research arms and technical personnel of the pulp and paper industry and, thus, improve the transfer of technological developments to the market place.

9. Finally, as outlined in the next section of this submission, a large increase in our investment, as a country, in our forest resource is required in areas relating to silviculture, forest protection, management and utilization. To support these efforts, more research and development is needed.

iv) Forestry Research and Development

Canadian forestry research has made some significant contributions to improvements in the basic understanding and management of the forest resource, as well as its utilization. As impending timber supply deficits develop, demand is becoming evident for rapid improvements in technology. Those institutions carrying out the research, and their programs, must therefore be made more efficient and effective. This can be achieved through a greater coordination among programs, and through better systems for the transfer of technology.

As is now recognized, the adequacy of the timber supply to satisfy present levels of production and future expansion is being seriously questioned. Three avenues are open to ameliorate the impending deficit in raw materials: greater protection of the forest resource; improved levels of timber utilization; and intensification of management practices to grow more timber more quickly. The success of the technology used in these endeavours will be strongly influenced by the quality of the supporting research and development programs.

Forestry has, through the work of a small number of research workers and by the adoption of innovative technology from elsewhere, been able to satisfy its technology requirements. The need for improved technology tailored to Canadian forest conditions is now obvious.

Forest research in Canada is carried out by a large number of agencies, with a minimum to moderate level of coordination of their programs. The Canadian Forestry Service of Agriculture Canada is the leading agency. The provincial governments are the owners of most of Canada's productive forests and therefore conduct research programs in support of forest management operations. The universities have contributed much to the present state of forest resource knowledge and technology. The industry has contributed directly to the research effort, and indirectly through cooperation with research organizations as well as through support of FERIC, PAPRICAN and FORINTEK.

To bring forest research programs to the level of excellence needed to assure the amount and quality of technology sufficient to help bridge the shift to more intensive resource management, several improvements must be made:

1. <u>Researchers and users of forest technology must coordinate their efforts in program planning and review</u>. Active participation by all sections of the forest industry on advisory bodies, from the national policy level to national and regional program review committees, will ensure that the programs are responsive to users' needs.

   Numerous advisory committees now exist in forestry, covering most subject areas and geographical regions. But two improvements are required; first, better coordination of programs throughout the system; and second, a more balanced

representation of clients and researchers in the guidance of programs.

The recent establishment of the Forest Research Advisory Council of Canada (FRACC) is a move to develop overall policy and coordination. This must be extended throughout the system.

For the advisory process to be productive, it must predict future needs. Strong representation from users must be a high priority. Industrial representation in the decision-making process is increasing, but must eventually reach a much higher level if meaningful technological developments are to result.

The universities' research programs must be more fully integrated into a coordinated system. Forestry faculties are the source of future forest managers and researchers and must be supported with constant research funding levels sufficient to ensure faculty and student excellence.

Linkages between the universities, other research agencies and the users of research must be strengthened through research and teaching chairs, advisory bodies and technology transfer programs.

2. <u>A problem common to many research areas, including forestry, is that of inadequate systems for the delivery of new technology to the users</u>.

New and innovative technology transfer systems are now needed to interpret scientific findings and encourage their more rapid introduction into the field. These must include reports written with the user as the intended reader, more seminars and workshops, and extension services bringing new technology to the production site.

3. Several specific areas of research should be given priority at this time:

   - Basic research into ecosystem functioning will help clarify many of the environmental questions now arising. Forest tree genetics research and tree improvement programs offer important sources of increased production.

   - Resource protection technology is in need of rapid improvement. This should include integrated pest management technology including biological and chemical pesticides as well as fire prevention and suppression methods.

   - Economic and strategic planning technology will allow a more efficient scheduling of harvesting and management and thereby improve our utilization of the forest land base and other limited resources.

- Research into silvicultural and harvesting systems and equipment promises to continue to yield significant improvements in growth rates and productivity.

The potential improvements in forest productivity in Canada make forest research a necessary and a wise investment in the future. If these returns are to be realized we must recognize and coordinate our efforts while encouraging joint direction of programs and an improved system of technology transfer to the forest and mill.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

A Brief to Minister of State for Science and Technology

Royal Society of Canada - Academy of Science

June 8-10, 1986
Winnipeg, Manitoba

THE ROYAL SOCIETY OF CANADA
LA SOCIÉTÉ ROYALE DU CANADA
344 WELLINGTON, OTTAWA, K1A 0N4, TEL. (613) 992-3468
ACADEMY OF SCIENCE/ACADEMIE DES SCIENCES

May 27, 1986

The Hon. Frank Oberle P.C., M.P.,
Minister of State for Science
and Technology,
C.D. Howe Building
240 Sparks Street,
Ottawa, Ontario
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Dear Mr. Oberle;

In response to your invitation to submit a paper to the Canadian Forum on a National Science Policy (Winnipeg, June 8-10, 1986) I am pleased to enclose, on behalf of the Academy of Science of the Royal Society of Canada, a brief containing recommendations and notes that relate to the recommendations.

Comments on the background paper "Building on our Strengths" and on the associated questionnaire were obtained from officers and a few other Fellows of the Academy in the short time available. These comments were taken into account in the preparation of the enclosed documents.

I look forward to attending the Forum and to possible future involvement of the Royal Society in the development of a science policy for Canada.

Yours sincerely,

for

A.T. Stewart
President of Academy
of Science,
Royal Society of Canada

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CANADIAN FORUM

ON

A NATIONAL SCIENCE AND TECHNOLOGY POLICY

A BRIEF

BY

THE ACADEMY OF SCIENCE

OF

THE ROYAL SOCIETY OF CANADA

TO

THE MINISTER OF STATE FOR SCIENCE AND TECHNOLOGY

MAY, 1986

CANADIAN FORUM ON A NATIONAL SCIENCE AND TECHNOLOGY POLICY.
A BRIEF TO THE MINISTER OF STATE FOR SCIENCE AND TECHNOLOGY
BY THE ROYAL SOCIETY OF CANADA - ACADEMY OF SCIENCE.

PART I SUMMARY AND RECOMMENDATIONS

1 INTRODUCTION

The Royal Society of Canada, through its Academy of Science, appreciates this opportunity to participate in the Canadian Forum on a National Science and Technology Policy. The subject is vital to Canada and must receive continued meaningful attention by all concerned with the nation's future.

The Academy of Science is well qualified to speak for Canadian science. The Fellows of the Academy are drawn from across the physical, applied, biological and medical sciences and include in their number many of the most creative and productive scientists in Canada, as recognized by their peers. Through the other Academies of the Society they can draw upon a similar depth of knowledge in the Humanities and Social Sciences. In the past the Society has undertaken a number of studies that demonstrate the importance of scientific knowledge in deciding social issues. For example: the Society organized an appraisal of the environmental effects of a nuclear war with special reference to Canada (i.e. a nuclear winter scenario) involving technical studies and a public forum; in partnership with the U.S. National Research Council it arranged a study of the Great Lakes Water Quality Agreement and its implementation. (see appendix for a more complete list of examples). It stands ready to develop further investigations that will be needed to establish a long-term policy for science and technology in Canada.

The background paper for the Forum, "Building On Our Strengths", focuses on many of the relevant issues. The complexity of these issues, however, cannot be overestimated. They affect basic aspects of Canadian culture and national values. The Royal Society, therefore, sees this forum as the beginning of a long and potentially fruitful process requiring both practical courses of action and continuing analysis of the importance for Canada of the actions taken.

2 RECOMMENDATIONS

1. **Canada must continue to perform basic research** as its contribution to human knowledge and to its own culture. The level of funding for such research should be about the same percentage of GDP as the average for OECD countries. This would require expenditures of the order proposed in NSERC's Five Year Plan.

2. **Canadian universities should continue to have the main responsibility for basic research.** Improved benefits could come from a larger number of research positions to assist the most productive researchers, and from closer coupling of some research to industry. The latter should not result in diminution of basic research support, as many fear.

The erosion of individual research grants over the last decade by university charges for various services is a serious matter that requires urgent federal/provincial resolution.

3. **University/Industry cooperation should be encouraged by governments** through suitable incentives, while ensuring that returns are real. Cooperation occurs when there is perceived benefit on both sides. Governments should encourage this by suitable incentives while ensuring that returns are real. Administrative procedures should be simple and allow for long-term planning. Current proposals of matching grants may be in the right direction but conditions must be clarified.

4. **Industrial research must be greatly strengthened** if maximum benefits are to be derived from domestic and international advances in science and technology. Innovations require well-prepared soil to take root and flourish. Government research laboratories and institutes are playing a larger role in assisting industry. Mission projects, where the bulk of the work is done in industry with some government laboratory involvement, are also helpful.

5. **Improved S&T training in industry should be pursued as a key to utilization of the most advanced technologies.** Universities can assist through teaching, expansion of cooperative programs for both students and industrial organisations and consultation on technical developments. Governments need to encourage S&T development by assisting with the modernization of facilities, the provision of tax measures that would reward high-risk pre-venture capital expenditures and the transfer of information on production and marketing of new technologies.

6. **Government laboratories,** a successful Canadian solution to the problems of immense territory, dispersed population and a fragmented, foreign-dominated industry, **should remain an essential ingredient of Canadian S&T** by providing standards, mission-oriented research and essential services not otherwise available. Increasingly, cooperative programs with industry, of which good examples exist, will be the way of the future.

7. Adapability to change is seen as basically a matter of education, training and open consultation. Individuals need to be prepared for change in a climate of expectation rather than fear. To make informed political choices in technological matters a

greater degree of scientific culture and literacy is required by the population at large; **education in science should start at the earliest school levels.**

8. Technology tends to prosper in industrial concentrations and is generally at a disadvantage in isolation. Thus **efforts to use technology to improve regional balance should be assessed carefully on an individual basis.** Economic competition is always present; where economic considerations are favourable, integrated technology packages can be an attractive means of introducing technologically advanced industry into a region of Canada and into less developed parts of the world. The resulting development of technical skills would be an important byproduct.

PART II ASPECTS OF A SCIENCE AND TECHNOLOGY POLICY

3 PREAMBLE

In this note the Academy reviews some problems and needs to be taken into account in developing a science and technology policy In the summary it makes a number of specific recommendations.

4 BACKGROUND

The Society is well aware of the many problems facing those charged with developing a policy for science and technology. The government of Canada gave leadership and focus to the reseach activities of the nation 104 years ago by creating our Royal Society and followed this 34 years later by founding the National Reseach Council of Canada (NRCC). Recent studies by NRCC, the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Science Council of Canada (SCC) underscore how much has yet to be done to respond to the need to maintain our position in a competitive world and to secure a bright future for the Canadian people.

NRCC, having devoted much of the first 50 years of its existence to strengthening the basic framework of Canadian science, has been giving increased attention over the last two decades to helping industry become more innovative and competitive. A major aim of NRCC's next five years, based on their plan, "A Practical Perspective", is to enlarge the base of industries involved in research from a present 2.5% to 5% of all technologically dependent Canadian companies. This alone is a challenging objective. There are others. As NSERC has pointed out, more than 50% of all researchers currently funded in Canada received their first degree and presumably their earlier education outside Canada. The files of the Royal Society tell a similar story. This heavy dependance on 'brain gain', as Dr MacNabb has called it, cannot be a reliable strategy for the future as other countries also contemplate shortages of scientists and highly skilled workers in the next decade. There are grave concerns that Canada is not doing enough to strengthen all levels of its educational system in order to address this situation, or to attract scientists and engineers from overseas.

The relatively buoyant position that had been developed by the late 1960's in basic and directed research in university and government laboratories has not withstood subsequent erosive forces of inflation and diversion of government funds to other priorities. The modest recovery effected by NSERC has partly restored university research funds but higher overheads and the trend to matching fund arrangements have greatly diluted the

apparent gains and bred uncertainty and concern among the academic research community. The resolution of the present climate of confusion demands immediate attention.

The view that many laboratories and research establishments in government line departments have served their purpose has been widely stated in recent years. Certainly the mandates under which such organizations operate and their research activities must be subject to periodic review, but changes in the existing system must be undertaken without destroying the national framework of research establishments that form a distinguished resource. The imperatives of our geography and climate and the emphasis Canadians place on quality of life must be respected in any change in balance between public and private research activities. The renewed interest in northern Canada and the expansion of Canada's offshore territories alone underline the need to keep an up-to-date resource inventory and to continue research in advance of immediate needs.

Scientists the world over recognize the need for greater efforts in explaining their work to the public at large. Undoubtedly they would welcome a like measure of increased understanding of science and its cultural as well as practical value on the part of those they address. Such educational aims are surely one of the principal objectives of any science policy for Canada.

5 THE SEARCH FOR A POLICY

Seeking a national policy requires a clear understanding of the terms involved. Policy is concerned with what should be done; strategy with how policy should be implemented. Policy must be agreed at least in broad terms before it is worth arguing detailed strategy. Arriving at a science policy means setting priorities to achieve objectives. Once objectives and their priorities are agreed, strategies can be formulated, costs estimated and an affordable program developed. The Forum will have achieved much if it can agree on how to determine a national policy for Canada.

The past successes of Canadian application of science to technology have come from excellent basic science, sound, well-managed application to Canadian conditions and aggressive competition on the global marketplace. In the future a more complex, more competitive yet more interdependent world may not require fundamental change to this successful formula, but will require clear recognition of the adaptations required to meet the new challenges. Successful application of new technology, whether indigenous or imported, requires basic understanding derived from high quality related research. Finally, a clear purpose, firmly based on the real capabilities and potential of Canadian

industry, is needed if increased research and development (R&D) expenditures are to improve significantly the health of the Canadian economy.

6 SCIENCE AND TECHNOLOGY

Although often treated as a single, indivisible entity, science and technology (S&T) cover a full range of related but distinct activities, each requiring individual treatment within the policy. All the activities from basic research through applied research, development, technology assessment, commercialization, trouble-shooting, etc. depend on S&T in making their contribution to economic growth.

The pursuit of science as natural philosophy remains an essential component of human inquiry, thought and speculation. Undoubtedly pure research over a broad range of topics as well as investigations targetted on specific problems are properly carried out in the university and have been from the earliest days of organized higher learning. Closer ties between universities and industry as well as increased funding for targetted research are current trends that must not result in a withering of the spirit of free inquiry that is the essence of fundamental research. The manner in which targetted research is directed must be assessed to avoid too narrow a focus of research efforts. Important problems require contributions from all who can assist significantly in the growth of knowledge. Thus, those working mainly in fundamental research can aid applied missions by monitoring the state of the art, advising on developments and assisting with unusual problems that may need unconventional solutions.

Successful basic research from which applied research flows needs the constant infusion from fresh, uninhibited minds and new viewpoints. The ability to work in teams must also be nurtured in these days of broad, multidisciplinary methods of attack. Canada is not alone in its concern over its aging research population and the dearth of promising young researchers to replace staff as they retire. NSERC in particular has documented and proposed solutions to these problems in its five-year plan, solutions which have the strong endorsement of the academic community at large. The measures adopted in the recent federal budget to increase funding need urgent clarification of the conditions under which industry may contribute to support of university research.

Applied research is an essential step in the transition from basic science to the development of technologies and their commercial exploitation. For some countries success in basic science has not always led to corresponding economic rewards while others have been highly successful in capitalizing on discoveries made elsewhere. Canada has achieved notable technological successes by emphasizing applied R&D, for example

by careful concentration of effort on specific products such as the Candu reactor, rape seed crops, the Canadarm, communication satellites or particular types of aircraft engines. The last example represents an instance of a branch plant under a world mandate producing and successfully marketing world-wide its own products under authorization from its parent company. A climate should be sought for encouraging further developments of this type.

These and other Canadian successes matched a product to a well-defined need. Even successful developments will fail if they are not needed in the market-place or because too many struggle over a relatively small and fragmented market. While to some extent this is the inevitable result of a free economy, government should make every effort to bring sound market advice to the assistance of the innovator.

Science and technology are needed far beyond the innovation stage. A new product must be nurtured carefully if it is to establish itself in a competitive environment. It is axiomatic that very practical, unforeseen problems will arise requiring further technical research for their resolution. The original R&D team is probably best suited to solve problems at this stage and during the subsequent developments needed to preserve a competitive edge.

7 TECHNOLOGY TRANSFER

Technology, whether imported or transferred domestically from the laboratory to industry, requires a substantial effort to absorb and support it. Communications between advanced researchers and market-oriented industrial personnel can be difficult. Universities have begun to meet this problem by facilitating consultation between academics, both professors and students, and industry. Improved liaison between universities and industry should be encouraged by appropriate funding that would allow small businesses to play an innovative and entrepreneurial role. Such measures would complement the lead given by the government through NRCC to double the number of Canadian firms involved in R&D.

The importation of a technology presents additional difficulties: an understanding of the real potential of a technology requires people knowledgeable in the field; literature rarely provides full insight into either the promise or the problems of an acquisition, and conditions will commonly be different from those in the country of origin. A heightening of the level of R&D in Canadian industry is the best means of realizing benefits from imported as well as domestic S&T and adapting and developing them to fit the needs of the country.

8 SECTORAL RESPONSIBILITIES

Each sector - university, industry and government - has its role to play in clarifying its contribution to S&T in Canada and in helping to formulate an overall policy. Each has its own strengths and weaknesses which deserve attention.

University

Universities, in fulfilling their purpose in education and the advancement of human knowledge, promote a tendency for new graduates to favour basic research as having greater prestige and the greatest potential for personal satisfaction. As noted, progress has been madein establishing centres of innovation and commercialization at some universities but more is needed, particularly to broaden students' understanding of the R&D environment.

Two particular difficulties confront Canadian universities in their efforts to maintain high research standards: first, the trend by university administrations to charge research support services to federal research grants, thereby effectively reducing the value of the grants; second, the uncertainty surrounding the level of funding to be expected from NSERC under the new matching grant formula. The former requires federal/provincial attention, while the latter needs an explanation of the means by which industry will be encouraged to realize the government's aims. These and other difficulties have seriously reduced the universities capacity to carry on their mandates.

Notwithstanding these problems, universities have shouldered their responsibilities for producing highly trained people for both basic and applied research at the leading edge of a broad educational effort to produce a workforce of skilled, adaptable individuals. They also perform basic research and collaborate with industry in advancing applied R&D.

Industry

Management and labour in the private sector taking advantage of government incentives have a responsibility to undertake the necessary training, to upgrade their skills and to exploit S&T at the state of the art in their industry. Greater use should be made of sabbatical-style exchanges between reseach centres and institutions in order that key researchers and managers remain relevant and viable in the changing world of technology.

Industrial research establishments in Canada include some excellent examples, such as Northern Telecom and Noranda, but the total number remains small at some 1250, and many branch plants do little more than maintain quality control over their products. An example of a good industry-association laboratory, is the Pulp and Paper Research Institute. Associations of this type can provides research support for many companies that are too small

to support independent R&D establishments. In general, industrial laboratories stress market-pull to direct their research but tend to be weak in their appreciation of new developments outside their own immediate areas of experience.

Government

Some government laboratories have achieved international standing and have been the mainstay of much of Canada's research in the past. With the maturing of research at universities and the growth of industrial R&D establishments, government laboratories have come under close and almost continuous review of their relevance and continued usefulness.

The nation will continue to require excellent research by government laboratories as well as the maintenance of standards and of data banks that government agencies now provide. These in turn require the expertise of research scientists to ensure that methods and equipment are current and that data receive essential expert interpretation. Staff have generally remained at or below the numbers of 15 years ago, but their role has changed. Much of what was done in-house at that time is now contracted out, with significant transfer of expertise to industry in the process. There is a limit to this, however, unless sufficient research is done by those supervising the contracts to maintain themselves at the cutting edge. Among the most responsive to change is NRCC, whose programs in support of industry are operating well at a relatively modest level and provide models for expansion as policies dictate. Other seed funds tend to be of such limited duration that little or no true research can be accomplished.

9 STRATEGY TO IMPLEMENT S&T POLICY

A Federal/Provincial strategy to implement an S&T policy should provide coordination and incentives, create an appropriate economic climate, assist in selected areas, support fundamental research at a level comparable to those of other advanced countries and, where necessary, provide a major part of the costs at the early stages of applied research. Such means as procurement policies should be used to assist implementation.

Once decided, government S&T policy should remain long-term and stable to encourage strategic planning and development. It should aim at simplifying interactions with industry, minimize duplication of effort and promote situations whereby branch-plants receive world mandates from their parent companies.

A national S&T strategy should distinguish between the development of technically advanced products from Canadian resources and those that have no special Canadian characteristics. Both have their place, but the former places more emphasis on technology drive while the latter requires justification in market pull.

10 ROLE OF THE ROYAL SOCIETY

The Royal Society welcomes the move towards a national policy for science and technology. It anticipates that this Forum will generate a number of studies as aspects of the policy are elaborated. The Society, an organization which includes leaders in all fields of scholarship, would wish to undertake several of these studies. It will also look to its membership for further contributions to discussion of issues. The policy considerations lie at the core of Canadian culture and scholarship, and the Society recognizes its responsibility to help in their identification, description and resolution for the benefit of all.

May, 1986

APPENDIX

A. REPORTS ISSUED BY THE ROYAL SOCIETY UNDER CONTRACT OR AGREEMENT

1 The Press of Knowledge (1978)

A study of policies and practices for publication of research journals in Canada. Commissioned by NRCC.

2 Nuclear Issues in the Canadian Energy Context (1979)

The proceedings of a conference held as the closing activity of the Committee on Nuclear Issues in the Community (CONIC). CONIC was established jointly by the Royal Society and the Science Council and was funded by the Department of Energy Mines and Resources and the Department of Fisheries and Environment.

3 Acid Deposition in North America (1983)

A review of documents, prepared under the Memorandum of Intent between Canada and the USA, (1980) on transboundary air pollution, for the Department of the Environment.

4 Long-range Transport of Airborne Pollutants in North America (1984).

A peer review of a Canadian federal research program for the Department of the Environment.

5 Nuclear Winter and Associated Effects (1985).

An appraisal of the environmental impact of nuclear war with special reference to Canada. Undertaken for the Department of the Environment.

6 The Great Lakes Water Quality Agreement: An Evolving Instrument for Ecosystem Management (1985).

A joint study by the Royal Society of Canada and the U.S. National Research Council of the Agreement and its implementation. The Canadian side was funded by the Donner Canadian Foundation.

7 Lead in Gasoline (1985)

A review of Canadian policy issues. An interim report by the Society's Commission on Lead in the Environment. The final general report of the Commission is to be submitted to the Department of the Environment late in 1986.

B. OTHER MATTERS

1 The International Council of Scientific Unions (ICSU) has proposed a new International Program on the theme of Global Change in the Geosphere/Biosphere. With support from NRC the Royal Society organized a workshop which has prepared a report "Global Change: The Canadian Opportunity" proposing possible actions by Canada relating to the Program.

2 The Society recently established a Committee on Ethics in Science to provide for Canadian liaison with ICSU studies on that subject. Funds are provided by NRCC in its role as the Canadian adhering body to ICSU.

3 Over the past fifteen years the Society has on its own initiative organized and published the proceedings of some thirty symposia on a wide range of topics.

DOCUMENT: 830-220/031

LA SOCIÉTÉ ROYALE DU CANADA
ACADÉMIE DES SCIENCES

MÉMOIRE AU MINISTRE D'ÉTAT CHARGÉ DES SCIENCES ET DE LA TECHNOLOGIE

CONFÉRENCE SUR LA POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

du 8 au 10 juin 1986
Winnipeg (Manitoba)

I[ère] partie: SOMMAIRE ET RECOMMANDATIONS

1. INTRODUCTION

La Société Royale du Canada, par le truchement de son Académie des sciences, est heureuse de participer à la Conférence sur la Politique nationale des sciences et de la technologie. Celle-ci sera d'importance cruciale pour notre pays, et il faut que tous ceux qui se préoccupent de l'avenir collectif lui accordent une attention digilente et constante.

L'Académie des sciences s'estime bien qualifiée pour se faire le porte-parole des scientifiques canadiens, car ses membres éminents proviennent des sciences physiques, appliquées, biologiques et médicales. Nombre d'entre eux comptent parmi ceux que leurs pairs reconnaissent comme les scientifiques les plus inventifs et les plus novateurs du Canada. Ils ont accès, par le truchement des autres Académies de la Société Royale, à une réserve semblable de compétences dans les sciences humaines. Dans le passé, la Société Royale a mené à bien un certain nombre d'études mettant en relief l'importance des connaissances scientifiques pour résoudre les problèmes sociaux. En voici des exemples: la Société Royale a concerté l'évaluation des effets d'une guerre nucléaire sur l'environnement, en particulier au Canada (éventualité de l'"hiver nucléaire"), grâce à des études techniques et à une conférence publique; en collaboration avec le National Research Council des É.-U., elle a organisé une étude de l'Accord sur la qualité des eaux des Grands Lacs, et de sa mise en oeuvre; une liste plus complète de ses initiatives figure à l'Annexe. La Société Royale se tient prête à mettre sur pied les études qui seraient nécessaires à l'élaboration d'une Politique à long terme des sciences et de la technologie au Canada.

Le document de travail établi pour la Conférence: "Les moyens de notre avenir" met en évidence un certain nombre de questions pertinentes. Mais on ne peut surestimer leur complexité. Elles touchent aux aspects fondamentaux de la culture des Canadiens

et à la hiérarchie de leurs valeurs. C'est pourquoi la Société Royale considère que cette Conférence est la première étape d'un long processus, éventuellement fructueux, qui nécessitera des actions concrètes et une analyse continue de leur importance pour notre pays.

2. RECOMMANDATIONS

1. Il faudrait que les scientifiques canadiens continuent leurs efforts de recherche fondamentale comme contribution à la culture du Canada et à la masse des connaissances humaines. La part du PIB canadien consacré au financement de tels efforts devrait atteindre la moyenne observée parmi les pays de l'OCDE. Les dépenses devraient donc rejoindre le niveau proposé par le plan quinquennal du CRSNG.

2. Les universités canadiennes devraient continuer à assurer la plupart des efforts de recherche fondamentale. L'accroissement du nombre des postes d'adjoints de recherches attachés aux chercheurs les plus féconds, et le resserrement de la collaboration entre certains laboratoires et entreprises industrielles permettraient de multiplier les avantages tirés de ces recherches. Il ne devrait pas résulter de ce rapprochement une diminution du financement de la recherche fondamentale, comme certains le craignent.

La ponction croissante opérée sur les subventions individuelles des chercheurs par la facturation de divers services fournis par l'université constitue, depuis dix ans, un problème sérieux qui exige une concertation urgente des organismes fédéraux et provinciaux compétents.

3. Il faudrait encourager la collaboration entre l'université et l'entreprise par des incitations convenables, en s'assurant que ses avantages sont réels. C'est l'existence d'intérêts réciproques qui engendre cette collaboration. Les formalités

administratives devraient être simples et faciliter la planification à long terme. Il se peut que les propositions actuelles de cofinancement à parts égales aillent dans le bon sens, mais il faudrait en clarifier les conditions.

4. L'effort de recherche industrielle devrait être fortement accru, pour tirer parti au maximum des progrès scientifiques et technologiques réalisés tant au pays qu'à l'étranger. Pour s'établir et se répandre, les innovations exigent la mise en place de conditions favorables. Les laboratoires de l'État et les Instituts de technologie jouent un plus grand rôle dans l'aide à l'industrie. Il est également utile de réaliser des projets thématiques où l'industrie accomplit la plupart des travaux, avec la collaboration occasionnelle des laboratoires de l'État.

5. Il faudrait poursuivre le perfectionnement scientifique et technique des cadres industriels, car il s'agit d'un facteur crucial de l'utilisation des technologies les plus avancées. Les universités peuvent y contribuer par leur enseignement, par le développement des programmmes d'enseignement et de travail alternés, tant pour les étudiants que pour les membres des associations de cadres industriels, et par les activités de consultance au sujet des progrès techniques. Il faut que les autorités publiques encouragent les progrès scientifiques et techniques en aidant à la modernisation des laboratoires, et en adoptant des déductions fiscales qui avantagent l'investissement exploratoire de capitaux-risque et la diffusion de l'information concernant l'utilisation des technologies nouvelles dans les activités de fabrication et de commercialisation des produits correspondants.

6. La création des laboratoires de l'État a été une réponse heureuse aux problèmes posés par l'immensité du territoire du Canada, la dispersion de sa population et la mainmise étrangère sur une partie de l'industrie. Ils devraient rester des éléments

essentiels des activités scientifiques et techniques au Canada, en élaborant des normes techniques, en accomplissant des recherches thématiques et en fournissant des services indispensables, non disponibles autrement. De plus en plus on mettra en oeuvre, en collaboration avec l'industrie, des programmes d'enseignement et de travail alternés, dont il existe de bons exemples.

7. On estime que l'adaptabilité aux changements découle essentiellement de l'éducation, de la formation et de la consultation directe des intéressés. Il faut préparer les travailleurs aux changements, dans un climat d'espoir plutôt que de crainte. La population en général doit acquérir une plus large culture scientifique et les connaissances nécessaires pour faire les choix politiques entre les diverses options techniques; l'enseignement des sciences devrait donc commencer dès les premières années d'école.

8. C'est dans les agglomérations d'entreprises industrielles que la technologie prospère; l'isolation lui est contraire. Il faut donc évaluer très soigneusement, dans chaque cas individuel, les possibilités d'utiliser les ressources technologiques pour réduire les disparités interrégionnales. La concurrence est toujours présente sur le plan économique, mais, si les facteurs économiques sont favorables, la mise en oeuvre d'un ensemble de technologies bien articulées peut permettre d'implanter des industries de pointe dans une région défavorisée du Canada ou dans des pays peu développés du Tiers-Monde. Il en résulterait un avantage important: le développement des compétences techniques locales.

DOCUMENT: 830-220/032

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Towards a Comprehensive Science and Technology Policy

Social Science Federation of Canada

June 8-10, 1986
Winnipeg, Manitoba

Social Science Federation of Canada
Fédération canadienne des sciences sociales

Suite 415, 151 Slater, Ottawa, Ontario K1P 5H3
Tel.: (613) 238-6112

Aid to Scholarly Publications Programme
Programme d'aide à l'edition savante

Suite 410, 151 Slater Ottawa, Ont K1P 5H3
Tel (613) 234-1269

May 27, 1986

Mr. John Gundy
Ministry of State for
Science & Technology
8th Floor West
C.D. Howe Building
235 Queen Street
Ottawa, Ontario
K1A 1A1

Dear Mr. Gundy:

Further to our telephone conversation of May 23, I enclose a short statement prepared by the Social Science Federation for the Forum on the National Science and Technology Policy. An information sheet on the Federation is attached, as an Appendix.

Our representative will be Dr. Alan Artibise, President-elect and Director of the Institute of Urban Studies of the University of Winnipeg.

I understand that you will have this document translated in French before the Conference: if that is the case, I would appreciate receiving a copy of the French version as soon as possible.

~~Yours sincerely,~~

Christian Pouyez
Executive Director

/11

cc: Dr. Alan Artibise, President-elect
Dr. Bernard Shapiro, President

Social Science Federation of Canada
Fédération canadienne des sciences sociales

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La Fédération canadienne des sciences sociales se consacre à l'avancement de la recherche en sciences sociales. A titre de porte-parole de la communauté des sciences sociales, la FCSS coordonne les efforts visant à améliorer les conditions de la recherche. Elle cherche aussi à favoriser dans le grand public une conscience accrue de l'apport des sciences sociales à la société canadienne.

R E N S E I G N E M E N T S

LA FEDERATION CANADIENNE DES SCIENCES SOCIALES

La Fédération canadienne des sciences sociales (FCSS) est un organisme à but non-lucratif, qui a été créé en 1940 sous le nom de "Conseil canadien de recherche en sciences sociales". Le nom actuel a été adopté en 1977. Située à Ottawa, c'est une fédération de sociétés savantes et d'organismes de recherche en sciences sociales, qui représente plus de 14,000 chercheurs.

Depuis sa formation, la Fédération a pris de nombreuses initiatives dans le domaine académique et culturel. De 1940 à 1957, elle fut la seule agence canadienne à subventionner la recherche en sciences sociales. La Fédération, de concert avec d'autres organisations, a exercé des pressions en vue de la création de la Commission Massey et, plus tard, du Conseil des arts du Canada, prédécesseur du Conseil de recherches en sciences humaines du Canada. De plus, la Fédération a assumé la responsabilité de la publication du premier grand Atlas du Canada et de plusieurs séries d'ouvrages de base tels que The Canadian Centenary History Series, Decision Making in Canada, The Atlantic Provinces Studies, Economic Growth, ainsi que des livres traitant du Grand Nord canadien.

ROLE DE LA FEDERATION

La Fédération a quatre fonctions majeures:

a) groupe de pression et d'intervention, elle fait connaître au gouvernement les besoins de la communauté des chercheurs et elle participe à la définition des politiques scientifiques;

b) centre d'information, la Fédération s'efforce de développer les liens entre le gouvernement et la communauté scientifique. La Fédération s'efforce également d'accroître, dans le grand public, la conscience de l'apport des sciences sociales à la société canadienne.

c) forum pour les associations de chercheurs en sciences sociales, la Fédération offre à ses associations membres de nombreuses occasions de rencontres et d'échanges sur des questions d'intérêt commun. La Fédération contribue ainsi au renforcement des liens au sein de la communauté savante au Canada.

d) organisme subventionnaire. En collaboration avec la Fédération canadienne des études humaines, la FCSS administre le Programme d'aide à l'édition savante. Les fonds de ce programme proviennent du Conseil de recherches en sciences humaines du Canada.

LES MEMBRES DE LA FCSS

La Fédération comprend trois catégories de membres:

Les membres ordinaires - associations d'envergure nationale en sciences sociales.

Les membres associés - universités, collèges, instituts et centres de recherches et autres organismes à but non-lucratif.

Les membres individuels - un maximum de 20 personnes élues par l'Assemblée générale en raison des compétences spéciales qu'elles peuvent apporter à la Fédération.

STRUCTURE

L'Assemblée générale, qui se réunit une fois par année, représente toutes les catégories de membres. La Fédération organise, en même temps que sa réunion annuelle, des ateliers portant sur les politiques de recherche et les problèmes d'intérêt particulier pour les membres.

Le Conseil d'administration est l'organe responsable de l'élaboration des politiques et de la gestion des affaires de la Fédération.

Le Bureau de Direction est composé des officiers élus de la Fédération -- le président, le président élu, les vice-présidents, le trésorier, le président sortant et tout autre directeur nommé par le Conseil. Entre les réunions du Conseil d'administration, le Bureau assume la responsabilité de la gestion des affaires courantes.

Lorsque le besoin s'en fait sentir, la Fédération crée des **groupes de travail** spécialisés, qui sont chargés de faire rapport sur des sujets précis.

Le **secrétariat,** situé à Ottawa, comprend un directeur général, quelques professionnels et du personnel de soutien.

FINANCEMENT

La Fédération canadienne des sciences sociales reçoit des cotisations de ses associations membres et des universités canadiennes ainsi qu'un octroi annuel du Conseil de recherches en sciences humaines du Canada. Elle bénéficie également de legs et de dotations telles que la Fondation Hurd.

ACTIVITES

Parmi les multiples activités de la Fédération, signalons principalement:

REPRESENTATION ET LOBBYING

La Fédération, seule ou avec des représentants d'autres secteurs de la communauté scientifique, rencontre régulièrement les autorités gouvernementales afin de discuter de questions portant sur les politiques et le financement de la recherche. De plus, la Fédération présente aux Conseils subventionnaires, aux ministères et aux commissions gouvernementales des mémoires qui traitent de sujets touchant les sciences sociales au Canada.

La Fédération organise également des rencontres entre ses cadres et les universités, collèges et centres de recherche, afin d'obtenir des idées, des opinions et de l'information pouvant servir à la définition des orientations de la Fédération.

INFORMATION

La Fédération publie Sciences sociales au Canada, le seul bulletin de nouvelles canadien conçu pour les chercheurs en sciences sociales. Sciences sociales au Canada, publié sept fois par an, est le principal instrument de liaison entre la Fédération, le gouvernement et la communauté universitaire. Le bulletin fournit des renseignements sur les plus récents développements dans des domaines tels que la législation fédérale et provinciale, les démarches de la Fédération auprès des autorités fédérales, la question du financement de la recherche, et toute autre question pouvant intéresser les chercheurs en sciences sociales.

En outre, la Fédération produit un programme de vignettes radiophoniques destinées à diffuser dans le grand public, sous une forme accessible à tous, les résultats des recherches en sciences sociales effectuées dans les universités canadiennes.

LA FEDERATION COMME FORUM

La Fédération organise des réunions annuelles des présidents d'associations, des secrétaires-trésoriers et des rédacteurs de revues. En plus, la Fédération offre un appui logistique et organise des activités dans le domaine de la sensibilisation du grand public lors du Congrès annuel des sociétés savantes. Elle facilite la communication et l'échange entre les membres de différentes disciplines et elle encourage les séances interdisciplinaires.

En outre, la Fédération aide les services d'information des universités où ont lieu les Congrès des sociétés savantes à assurer une couverture de presse efficace à cet évènement annuel majeur.

AIDE A L'EDITION SAVANTE

La Fédération, en collaboration avec la Fédération canadienne des études humaines, gère le Programme d'aide à l'édition savante, dont les fonds proviennent du Conseil de recherches en sciences humaines du Canada. Le programme vise à promouvoir la publication de travaux qui contribuent de façon importante au développement des connaissances dans le domaine des sciences sociales. Le programme subventionne environ 150 livres par année.

MEMBRES ORDINAIRES

Association canadienne de communication (ACC)
Association canadienne d'économique (ACE)
Association canadienne d'études du développement international (ACEDI)
Association canadienne pour l'étude de l'éducation des adultes (ACEEA)
Association canadienne des études prospectives (ACEP)
Association canadienne des géographes (ACG)
Association canadienne des professeurs de droit (ACPD)
Association canadienne de recherche et d'éducation pour la paix (ACREP)
Association canadienne des relations industrielles (ACRI)
Association canadienne de science politique (ACSP)
Association canadienne des sciences régionales (ACSR)
Association des études canadiennes (AEC)
Association des sciences administratives du Canada (ASAC)
Fédération canadienne de démographie (FCD)
Institut d'histoire de l'Amérique française (IHAF)
Professeurs d'économie familiale des universités canadiennes (PEFUC)
Société canadienne d'ethnologie (SCE)
Société canadienne pour l'étude de l'éducation (SCEE)
Société canadienne pour l'étude de l'enseignement supérieur (SCEES)
Société canadienne de psychologie (SCP)
Société canadienne de sociologie et d'anthropologie (SCSA)
Société historique du Canada (SHC)
Société québécoise de science politique (SQSP)

MEMBRES ASSOCIES

Universités:

Acadia - Alberta - Athabasca - Bishop's - Brandon - British Columbia - Brock - Calgary - Cape Breton - Carleton - Collège universitaire de Saint-Boniface - Concordia - Dalhousie - Ecole nationale d'administration publique - Guelph - King's College - Lakehead - Laurentian - Laval - Lethbridge - Manitoba - McGill - McMaster Memorial - Moncton - Montréal - Mount Allison - Mount Saint Vincent - New Brunswick OISE - Ottawa - Prince Edward Island - Québec à Chicoutimi - Québec à Montréal - Québec à Rimouski - Québec à Trois-Rivières - Québec à Hull - Queen's - Regina - Royal Military College of Canada - Royal Roads Military College - Sainte-Anne - St. Francis Xavier - St. Mary's - St. Michael's College - Saint-Paul - St-Thomas - St-Thomas More College - Saskatchewan - Saskatchewan Indian Federated College - Sherbrooke - Simon Fraser - Sudbury - Toronto - Trent - Victoria - Victoria (To.) - Waterloo - Western Ontario - Wilfrid Laurier - Windsor - Winnipeg - York

Autres organisations:

Association des bibliothèques de recherche du Canada
Association canadienne des écoles de service social
Bibliothèque du Parlement
L'Institut d'administration publique du Canada
L'Institut d'études urbaines
Population Research Laboratory
Social Science Computing Laboratory
Social Science Data Archives

Social Science Federation of Canada
Fédération canadienne des sciences sociales

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The Social Science Federation of Canada works to promote the research and represent the interests of researchers in the various social science disciplines. The Federation also aims to accomplish an improved public understanding of the role played by the social sciences in people's everyday lives.

INFORMATION

WHAT IS THE SOCIAL SCIENCE FEDERATION?

The Social Science Federation of Canada (SSFC) was established in 1940 as the Social Science Research Council of Canada. A non-profit organization with registered charity status, the Federation was incorporated under its present name in 1977. The Federation, located in Ottawa, unites academic social science associations and related organizations representing more than 14,000 Canadians working in the various social science disciplines.

Since its formation, the Federation has been a driving force behind many Canadian academic and cultural initiatives. From 1940 to 1957, it was the only Canadian funding agency for social science research. The Federation, with others, pressured for the establishment of the Massey Commission and later the Canada Council, from which was derived the present granting council for the social sciences, the Social Sciences and Humanities Research Council of Canada. The Federation was also responsible for the publication of the first comprehensive Atlas of Canada and of several fundamental series of books such as The Canadian Centenary History Series, Decision Making in Canada, The Atlantic Provinces Studies, Economic Growth, and a series on the Canadian North.

ROLE OF THE FEDERATION

The Federation has four major roles:

a) as an interest group, enabling the Canadian academic social science community to convey its needs to the government and its agencies, and be instrumental in the development of science policy.

b) as an information gathering and dissemination centre. The SSFC acts as the essential liaison within the Federation-government-university triad. In addition, the Federation aims at increasing a public awareness of the contributions of the social sciences to Canadian society.

c) as a forum for the associations of researchers in the social sciences. As an organization grouping twenty-three disciplinary and interdisciplinary societies, the SSFC plays a unique role as a forum where ideas and experience can be exchanged. This forum greatly contributes to the development of the Canadian community of scholars.

d) as a funding organization. The SSFC administers the Aid to Scholarly Publications Programme in collaboration with the Canadian Federation for the Humanities. The funds for this programme are provided by the SSHRCC.

FEDERATION MEMBERSHIP

The Social Science Federation of Canada has three categories of membership:

Constituent Members - national social science associations

Associate Members - universities, colleges, research centres and institutes and other non-profit research-oriented organizations

Members-at-large - up to twenty persons elected by the General Assembly for the special contributions they can make to the aims of the Federation.

STRUCTURE

The **General Assembly,** which meets once a year, represents all three categories of membership. In conjunction with its annual meeting, workshops are held on policy issues and problems of special interest to members.

The **Board of Directors** is the governing body responsible for developing the policies and conducting the affairs of the Federation.

The **Executive Committee** is composed of officers of the Federation -- the President, President-Elect, Vice-Presidents, Treasurer and immediate Past-President, and such other Directors as the Board appoints. Between meetings of the Board of Directors, the Executive Committee oversees and plans the affairs of the SSFC.

Task forces are created to deal with specific projects as the need arises.

The **Secretariat,** in Ottawa, has a small professional and support staff directed by an Executive Director.

FUNDING

The Social Science Federation of Canada is supported by contributions from its member organizations and Canadian univerities together with an annual grant from the Social Sciences and Humanities Research Council of Canada and bequests and endowments such as the Hurd Fund.

ACTIVITIES

The following are some of the principal activities of the Federation:

PRESENTATION AND LOBBYING

The Federation meets regularly with government authorities to discuss questions focussing on research policy and funding. The Federation presents briefs to funding agencies, government departments, commissions and Task Forces on subjects affecting the social sciences in Canada. Such activities are undertaken either by the Federation alone or in collaboration with groups representing other sectors of the scientific community.

The Federation organizes visits by its Officers and Executive Director to universities, colleges and other centres of research to exchange ideas, opinions and information in order to determine future priorities.

COMMUNICATION

The Federation publishes Social Sciences in Canada, the only newsletter in Canada written specifically for the 14,000-strong social science community. Social Sciences in Canada, published seven times a year, is the major vehicle of communication within the Federation-government-university triad. Information is given on such topics as recent federal and provincial legislation, SSFC interaction with the federal government, funding of research and other topics of interest to the social science community.

As part of its public awareness activities, the Federation produces a series of radio clips on research results in the social sciences. These programmes are broadcast to the general public over private radio stations across Canada.

THE FEDERATION - A FORUM

The Federation organizes annual meetings for presidents of member associations; secretary-treasurers and journal editors.

The SSFC offers logistical support and public awareness acitivities for the Learned Societies Conference each year, including assistance in organizing meetings between the members of different associations and support for interdisciplinary sessions. The Federation assists the information services at the host university for the Learned Societies Conference in assuring effective media coverage of this major annual event.

AID TO SCHOLARLY PUBLICATIONS PROGRAMME

The Social Science Federation, with the collaboration of the Canadian Federation for the Humanities, administers the Aid to Scholarly Publications Programme. The Programme, funded by the Social Sciences and Humanities Research Council of Canada, assists in publishing works of advanced scholarship which make a important contribution to the furthering of knowledge in the social sciences and humanities. The Programme supports approximately 150 books a year.

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Canadian Association for International Development Students (CAIDS)
Canadian Association of Geographers (CAG)
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Canadian Association for the Study of Adult Education (CASAE)
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Canadian Industrial Relations Association (CIRA)
Canadian Peace Research and Education Association (CPREA)
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Canadian Sociology and Anthropology Association (CSAA)
Canadian University Teachers of Home Economics (CUTHE)
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Canadian Association of Research Libraries
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Library of Parliament
Population Research Laboratory
Social Science Computing Laboratory
Social Science Data Archives
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TOWARDS
A COMPREHENSIVE
SCIENCE AND TECHNOLOGY POLICY

A Statement by the
Social Science Federation of Canada
in Preparation for the
National Forum on the National
Science and Technology Policy

May 24, 1986

INTRODUCTION

The primary objective of this paper is to offer a rationale for expanding the current approach to science and technology policy to encompass the important and unique contributions that the social science can make to Canada's scientific effort. Without minimizing the need for increased research and development investments in the natural sciences and engineering, nor the necessity of developing and adopting new technologies, the paper argues that a more comprehensive, less reductionist approach to economic growth and prosperity requires a systematic consideration of the contributions the social sciences can make to the efficient use of existing and new physical technologies. Otherwise, Canada risks experiencing a phenomenon of over-accumulation of technologies without being able to utilize them. Greater and more systematic resort to the social sciences is required if Canada is to reap the maximum benefits of its substantial R&D investments in the natural and engineering sciences.

Technological Development: A Social Process with a Technological Component

R&D in the natural sciences and engineering is a necessary but insufficient condition for technological development and innovation to occur. From a broad policy perspective, the complex process by which technological innovation occurs is best understood as a social process with a technological component. The slow pace of innovation in Canada and the high rate of failure of innovations cannot be explained solely by inadequate, inappropriate or insufficient R&D in the natural sciences, wherever performed. Very often, they are the result of market, managerial and organizational factors. The quality of human resources is another important determinant of the innovation process. It should be clear to everyone, for example, that without a skilled, socially sensitive and

expert management capable of seizing new opportunities, no amount of high technology, however available, will transform a poorly managed firm into an efficient one.

Economic growth and productivity cannot be reduced to changes in physical technologies. It requires social technology and innovations as prerequisites and complements to the adoption of new physical technologies. In fact, social innovations may result in productivity gains over and above those attributable to physical technology alone. Considerable productivity gains can also come about by incorporating what is currently "best practice"[1], as well as routine adaptations of existing technology. Indeed, motivation and the quality of work life are important determinants of productivity when we consider that in the late 1970s the Canadian economy was losing some 83 million workdays per year through absenteeism alone, at an estimated cost of over $20 million a day. Technology change per se holds very few promises of solving such social problems which are undermining Canada's economic performance.

To the same extent that technical problems of production find scientific solutions, they are transformed into as many human and social problems. Technological change will render obsolete entire categories of knowledge, professional skills and occupations. The new technologies will dramatically alter our employment structure and skill needs, as well as offer the prospect of a bi-polarization of the labour force. The fact that all too little is known about the social impacts of technology development serves only to fuel resistance to change. Greater and more systematic resort to the social sciences is needed if Canada is to give timely and adequate

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[1] Peters, T.J. and Waterman, R.H., In Search of Excellence, New York: Harper and Row, 1982.

consideration to the assessment of the socio-economic implications of particular technologies on Canadian society. While foreign experiences may be instructive, such knowledge can neither be easily imported nor always assumed to apply in Canada.

Policy Implications

The preceding section sought to provide a rationale for the integration of the social sciences as a central element of a national science and technology policy. Three sets of consideration were highlighted:

- in view of the complexity of the innovation process, a science and technology policy cannot afford to place exclusive emphasis on R&D in the natural and engineering sciences. Such a policy must give due consideration to the social determinants (e.g. market assessments, managerial, sociological, psychological, historical and organizational factors) of both the stimulation and success of the innovation process. Social science research can shed considerable light upon these determinants. A great deal can be gained from the development of a science and technology policy which recognizes the role of social factors in the successful employment of technological innovations, as well as the contribution social innovations can make to the efficient use of capital and labour inputs.

- For science and technology policy to reap the benefits for which it is intended, it must integrate measures to stimulate technology development with measures to ensure its diffusion. The factors which have been identified as

important to the process of diffusion (e.g. size of firm, degree of capital embodiment, management style) point to the importance of understanding the structure of the industry involved, the nature of its markets and the regulatory constraints under which it operates. Social science research can contribute to the understanding of these factors and thereby provide a foundation upon which to develop a more integrated approach to promoting the diffusion and adaptation of technology.

- Finally, adequate and timely consideration must be given to the assessment of the impact of particular technologies on the social environment

While the relevance of the social sciences to a national science and technology policy is unquestionable, little effort has been made to capitalize on their potential, and promote and facilitate their contributions to Canadian society. One of the major stumbling blocks is the amount of research support available in the social sciences, relative to the range of issues at hand. By way of illustration:

- currently (1986), activities in the natural sciences and engineering receive approximately 78% of the total federal expenditures on scientific activities (Science Statistics, Service Bulletin, March 1986);

- while 73% of the total federal expenditures in the natural sciences and engineering are spent on R&D and the remaining 27% on related scientific activities (RSA), the reverse is true in the social sciences where only 20% of federal expenditures in this area are allocated to research support

- relative to the GNP, human science research (e.g. social sciences and humanities) support has fallen by an estimated 35% since 1971.

These indicators suggest that there is a need to arrest the erosion of federal support of the social sciences and to re-establish a healthier balance of federal resources allocated to the various scientific fields. The social sciences offer a diversified portfolio whose major problem stems less from under-development, than from the under-utilization of its human capacity.

It should also be clear that Government must avoid sacrificing long-term "basic" research in a rush to develop an applied capacity in the social sciences. A balanced approach, promoting the development of a comprehensive research capacity - fundamental and applied, disciplinary and multidisciplinary - is more likely to enhance the contributions of the social sciences to society than a state directed or market driven policy to promote applied research. In this perspective, the recently announced policy of matching private sector contributions scheme designed to provide the three granting councils with additional resources is ill-adapated to the social sciences and risks unduly promoting applied research at the expense of long-term theoretical research[1].

While the market for social science knowledge is not limited

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[1] **"Shared Government-Private Sector Support of Academic Research"**, Social Science Federation of Canada, April 1986

to private enterprise, the exclusion of the social sciences from the definition of scientific research under the Income Tax Act presents a major obstacle to the development of university-industry cooperation in the social sciences.

Finally, the social sciences would benefit from the development of a human science policy framework designed to facilitate the integration of the human sciences into a science and technology policy. The goal is to establish the human sciences on a sound footing while at the same time developing structures and measures that will lead to a more comprehensive approach to Canadian science and technology policy.

INTRODUCTION

L'objectif premier du présent document est d'expliquer pourquoi il faudrait élargir la position actuelle de la politique scientifique et technologique, de manière à englober les contributions importantes et uniques que les sciences sociales peuvent apporter dans l'effort scientifique canadien. Sans minimiser la nécessité d'investissements accrus en recherche et en développement dans les domaines des sciences naturelles et du génie, ni la nécessité de mettre au point et d'adopter de nouvelles techniques, nous estimons qu'une ligne de conduite plus large et moins compressive concernant la croissance économique et la prospérité exige un examen systématique de ce que les sciences sociales peuvent apporter comme contributions dans l'utilisation efficace des techniques physiques existantes et nouvelles. Autrement, le Canada risque de connaître un phénomène de suraccumulation des techniques sans être capable de les utiliser. Le Canada doit faire appel de façon plus fréquente et systématique aux sciences sociales s'il veut tirer un profit maximum de ses investissements importants en R-D dans les domaines des sciences naturelles et du génie.

Développement technologique : un processus social assorti d'un élément technologique

La R-D en sciences naturelles et en génie est une condition nécessaire mais insuffisante pour que se produisent le développement et l'innovation technologiques. Du point de vue d'une politique générale, la meilleure façon de comprendre le processus complexe de l'innovation technologique est de la considérer comme un processus social assorti d'un élément technologique. Il est impossible d'attribuer la lenteur de l'innovation au Canada et l'échec fréquent des innovations mêmes uniquement à une R-D inadéquate, inappropriée ou insuffisante en sciences naturelles, peu importe son lieu de réalisation. Très souvent, les facteurs en cause sont le marché, la gestion et l'organisation. La qualité des ressources humaines est un autre facteur fortement déterminant du processus d'innovation. Tout le monde doit comprendre, par exemple, que, sans une gestion qualifiée, sensible aux faits sociaux, experte et capable de saisir de nouvelles occasions, aucun emprunt à la haute technologie, toute disponible qu'elle est, ne pourra transformer une entreprise mal gérée en une entreprise efficace.

La croissance économique et la productivité ne peuvent se réduire à des changements dans les techniques physiques. Des techniques et des innovations à caractère social doivent précéder et compléter l'adption de

nouvelles techniques physiques. En fait, les innovations sociales peuvent entraîner des gains de productivité qui dépassent de loin ceux qui sont attribuables aux techniques physiques seulement. On peut aussi obtenir des gains considérables de productivité en incorporant les "meilleures pratiques"[1] du moment ainsi qu'en adaptant de façon courante la technologie existante. En effet, la motivation et la qualité de la vie au travail sont d'importants facteurs déterminants de la productivité, si nous tenons compte du fait que, vers la fin des années 70, l'économie canadienne perdait environ 83 millions de journées de travail par an en raison uniquement de l'absentéisme, ce qui représentait un coût estimatif de plus de 20 millions de dollars par jour. L'évolution technologique en soi promet bien peu de résoudre ces problèmes sociaux qui minent le rendement économique du Canada.

Dans la mesure où des problèmes techniques de production trouvent des solutions scientifiques, ils sont aussi transformés en autant de problèmes humains et sociaux. L'évolution technologique va rendre désuètes des catégories entières de connaissances, d'aptitudes et de professions. Les nouvelles techniques vont changer de façon spectaculaire notre structure d'emploi et nos besoins de compétences, et elles offrent la perspective d'une bipolarisation de la population active. Le fait qu'on connaît trop peu les conséquences sociales des progrès technologiques ne peut servir qu'à alimenter la résistance au changement. Le Canada doit recourir plus largement et systématiquement aux sciences sociales s'il veut parvenir à tenir compte avec promptitude et pertinence de l'évaluation des conséquences socio-économiques de certaines techniques. Bien que les expériences à l'étranger puissent être utiles, une telle connaissance ne peut être facilement importée ni s'appliquer nécessairement et dans tous les cas au Canada.

Conséquences sur le plan des politiques

La section précédente visait à motiver l'intégration des sciences sociales comme élément central d'une politique scientifique et technologique nationale. Nous avons mis en lumière trois types de considérations :

- Compte tenu de la complexité du processus d'innovation, une politique scientifique et technologique ne peut se permettre d'insister

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1 Peters, Thomas, et Waterman, Robert, Le prix de l'excellence, Paris, InterÉditions, 1983.

exclusivement sur la R-D en sciences naturelles et en génie. Une telle politique doit bien prendre en considération les facteurs sociaux déterminants (par ex., évaluations du marché, facteurs gestionnels, sociologiques, psychologiques, historiques et organisationnels) de la stimulation et du succès qui résultent du processus d'innovation. La recherche en sciences sociales peut jeter beaucoup de lumière sur ces facteurs déterminants. Il peut y avoir beaucoup à tirer de l'établissement d'une politique scientifique et technologique qui reconnaît le rôle des facteurs sociaux dans l'utilisation réussie des innovations technologiques, aussi bien que la contribution possible des innovations sociales dans l'emploi efficace des apports de capitaux et de main-d'oeuvre.

- Pour produire les résultats escomptés, la politique scientifique et technologique doit intégrer les mesures pour stimuler le développement technologique avec les mesures qui assureront sa diffusion. Les facteurs qui ont été identifiés comme essentiels au processus de diffusion (par ex., la taille de l'entreprise, le degré de capitalisation, le style de gestion) montrent l'importance de comprendre la structure de l'activité économique en cause, la nature de ses marchés ainsi que les lois et règlements qui régissent son fonctionnement. La recherche en sciences sociales peut contribuer à faire comprendre ces facteurs et fournir ainsi une base à partir de laquelle il est possible de promouvoir de façon plus intégrée la diffusion et l'adaptation de la technologie.

- Enfin, il faut tenir compte promptement et de façon pertinente de l'évaluation des conséquences de certaines techniques sur le milieu social.

Bien que la pertinence des sciences sociales au sein d'une politique scientifique et technologique nationale soit indiscutable, on a fait peu d'efforts pour miser sur leur potentiel ainsi que pour promouvoir et faciliter leurs apports dans la société canadienne. L'une des principales pierres d'achoppement est le volume de soutien à la recherche dont disposent les sciences sociales par rapport à la gamme des sujets à l'étude. Ainsi :

- pour l'année en cours (1986), environ 78 % de l'ensemble des dépenses fédérales au titre des activités scientifiques vont à des activités en sciences naturelles et en génie (Statistique Canada, <u>Statistique des sciences - Bulletin de service</u>, mars 1986);

- bien que 73 % du total des dépenses fédérales dans les domaines des sciences naturelles et du génie soient affectées à la R-D et le reste (27 %), aux activités scientifiques connexes (ASC), c'est une situation opposée dans le domaine des sciences sociales, en ce sens que seulement 20 % des dépenses fédérales dans ce domaine visent le soutien à la recherche;

- par rapport au PNB, le soutien accordé à la recherche en sciences humaines (c.-à-d. en sciences sociales et en lettres) a diminué, selon les estimations, de 35 % depuis 1971.

Ces indicateurs démontrent la nécessité d'arrêter l'érosion du soutien fédéral pour les sciences sociales et de rétablir un meilleur équilibre dans les ressources fédérales affectées aux divers domaines scientifiques. Les sciences sociales offrent un portefeuille diversifié dont le problème majeur tient moins au sous-développement qu'à la sous-utilisation de ses capacités humaines.

Il devrait aussi être évident que l'État doit éviter de sacrifier la recherche "de base" à long terme dans sa hâte pour développer la recherche appliquée en sciences sociales. Une formule équilibrée, qui encouragerait l'implantation d'une capacité de recherche polyvalente - fondmentale et appliquée, disciplinaire et multidisciplinaire - aurait plus de chances d'accroître la contribution des sciences sociales dans la société qu'une politique dirigée par l'État ou dépendante du marché qui viserait à promouvoir la recherche appliquée. Dans cette perspective, la politique d'appariement des fonds annoncée récemment - laquelle vise à fournir aux trois conseils pourvoyeurs de subventions des ressources supplémentaires équivalentes aux contributions du secteur privé - est mal adaptée aux sciences sociales et risque de promouvoir indûment la recherche appliquée aux dépens de la recherche théorique à long terme.[1]

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1 "Shared Government-Private Sector Support of Academic Research", Fédération canadienne des sciences sociales, avril 1986.

Bien que le marché des connaissances en sciences sociales ne soit pas limité aux entreprises privées, l'exclusion des sciences sociales de la définition de la recherche scientifique selon la Loi de l'impôt sur le revenu constitue un obstacle majeur à l'épanouissement de la collaboration entre les universités et le secteur privé dans le domaine des sciences sociales.

Enfin, les sciences sociales bénéficieraient de l'établissement d'une position de principe particulière qui viserait à faciliter l'intégration des sciences humaines dans une politique scientifique et technologique. L'objectif est d'offrir une assise aux sciences humaines tout en établissant des structures et des mesures qui contribueront à élargir le champ d'action de la politique scientifique et technologique du Canada.

DOCUMENT: 830-220/033

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Statement to the Ministry of State for Science and Technology

Agricultural Institute of Canada

June 8-10, 1986
Winnipeg, Manitoba

J. Gowdy
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04-06-86

AGRICULTURAL INSTITUTE OF CANADA

STATEMENT TO MOSST

JUNE 8 - 10, 1986

The agricultural industry built Canada. It was the engine which drove the economy and provided the impetus for the development of other industries, Canadian scientific capacity and a large part of the nation's infrastructure. Today, we enjoy the legacy of Canada's first farmers both as a secure food supply and as a vital element in the national economy. It would be folly to suggest that agriculture, alone, can continue to build Canada. Nevertheless, it has been proven beyond a shadow of a doubt that agricultural R&D is one of the best possible investments, public or private. Annual returns of 40% or more are possible. Any science and technology policy must recognize the vital importance of agriculture to the nation and the importance of research to agriculture.

Expanded research can help provide the solutions to serious agricultural problems such as soil erosion which presently costs the nation $1 billion annually. Research can provide farmers with the tools to produce more efficiently, ensuring Canada's place in world markets.

1. The Government of Canada should, over the next five years, increase its support for agricultural research and development by at least 60 percent. (Based on a proportionate share of the increase from 0.9 to 1.5 percent of the GNP.)

2. The increased support should be utilized to strengthen all components of the total Canadian agricultural research system: Agriculture Canada, the provinces, the faculties of agriculture and colleges of veterinary medicine, and the private sector.

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3. The Research Branch of Agriculture Canada should continue to be the major research agency for agriculture and food.

4. University research capability should be greatly strengthened particularly in basic research and "frontier" research areas. In this, a stronger relationship should be established between research and post graduate training of students. To stimulate post graduate training and associated research. Agriculture Canada should support 50 graduate students per year in disciplines headed for short supply. Support should include supply of research facilities, equipment and operating funds.

5. The provincial departments of agriculture should have as one of their goals the expansion and upgrading of agricultural research centres at the universities in order to provide the facilities which will be required to house and service the expected increase in research support for students and staff.

6. Agriculture Canada's present contractual system with the private sector and the universities should be reviewed by the CARC with the objective of determining what changes could be made in the contract system which would be more acceptable to the universities and industry while at the same time maintaining the essential aims and objectives of the department.

7. To stimulate the development of lasting research capability within the private sector, the Government of Canada should provide improved tax incentives for industrial research and development.

8. The Canadian Agricultural Research Council should have an independent secretariat and a budget independent of Agriculture Canada's Research Branch that would be sufficiently large to carry out a diversified study of overall needs and weaknesses of the total agricultural R&D system in Canada. In this capacity CARC should have the mandate to review in detail any or all research being conducted by Agriculture Canada, universities, provinces and any other institutions using public funds.

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9. More emphasis should be placed on applied research. Basic research conducted elsewhere may be adapted to Canadian use.

10. Coordination between federal, provincial, and private research must improve to avoid duplication of work and facilities. Cooperative research and development is underway in the United States, the United Kingdom, the Netherlands and West Germany and their approaches are worthy of study.

11. More money and effort must be put into the transfer of new technology to the producer level.

12. Particular attention should be paid to biotechnology or genetic engineering as applied to plant and animal breeding. It should not be viewed as a science unto itself but rather as an integral part of the sciences of plant and animal breeding.

Finally, we view the background paper as a sound basis from which to work. We believe, however, that it can be improved by addressing Canadian agricultural R&D specifically, in terms of the above comments.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

University Based Business Incubators High Leverage Development Tools for Technology Based Industry

EPYTEC Prototypes Inc.

June 8-10, 1986
Winnipeg, Manitoba

UNIVERSITY BASED BUSINESS INCUBATORS

High Leverage Development Tools for Technology Based Industry

by

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Business incubators are organizations that assist people to plan, organize, finance and start new enterprises based on their own ideas. Incubators provide information, contacts, experience, management and psychological support for new businesses. Incubators may also provide working space and support services for early-stage companies. Most incubators accommodate a wide variety of new enterprises and do not specialize.

In contrast, University Based Business Incubators (UBBIs) deal with a highly preselected clientele (university graduates and faculty), and with technically based projects which are often at the end of a long research and development period. But these potential entrepreneurs are short of business experience, have no financial resources, and still need help with product engineering. They may well be two years and $200,000 away from a marketable product and a completed business plan.

The creation of enterprises based on university research requires a special kind of incubator, in which applied research, product development, and sophisticated prototyping can proceed in parallel with market research and business planning.

In the course of organizing a business incubator at the University of British Columbia that would serve the graduates of the UBC engineering physics program, we have reviewed a number of university based technology transfer schemes both in Canada and the United States. This paper summarizes some of our major conclusions about University Based Business Incubators (UBBIs).

Since UBBIs are high leverage economic development tools, this paper has implications for both science policy and economic policy.

THE NEED FOR UBBIs

Scientific research in the university creates the technological basis for new commercial products and industries. Between the end of university research and the successful startup of the new enterprise lies a series of tasks and requirements which are hard to complete in a university setting. They include:

- market research and a marketing plan
- concept and design of a marketable product
- production design and prototyping
- a complete business plan
- the recruitment of a qualified management team.

This work must be completed before the new company can obtain adequate financing. Work in this area is generally not supported by existing government programs, either in the science or small business areas. Hence we have called this phase in the development of an enterprise the "post research pre business plan gap". The UBBI ensures that the new companies successfully bridge this gap.

The UBBI has a special advantage arising from its position in the university community. The individuals that form the basis of the new companies are some of the best and brightest of our graduates, who have learned to work fast and effectively. The technological concepts may be the results of the most recent research. The UBBI can provide the necessary post degree education and support, in both technical and business areas, needed to transfer this technology.

Many universities have programs designed to link research and classroom work to industrial experience, including the Shad Valley Program, Co-op Programs, and advanced Design Labs. For many students, there will be a clear linkage between their university experience and the possibility of going into business. The incubator can open opportunities to embark on a new type of career opportunity.

OPERATION OF A UBBI

In order to be accepted into the UBBI, potential projects must be carefully screened for both technological soundness and market suitability. The project leaders must demonstrate the initiative and commitment necessary to carry them through the startup period. This screening would involve the incubator staff and an advisory group drawn from successful entrepreneurs and university faculty.

As soon as a project starts in the incubator, the entrepreneur and his team should incorporate a company. Essential items such as legal responsibilities, books of accounts, appointment of officers and definition of responsibilities, corporate identity, etc. should follow quickly. This helps to emphasize the difference between university research and the business priorities.

Companies in the incubator will be expected to make steady progress towards completion of the technical, marketing, team building, and planning aspects of their work. Regular progress reviews would be carried out in conjunction with company directors; meeting performance milestones would be a condition of continued residence in the incubator. A typical tenancy would last two years. This compares with the three to five years which a number of existing technology based companies have required to get into production.

In the incubator, the new enterpreneur would have wide exposure to other members of the entrepreneurial community, particularly his peers in the facility. He would have easy access to university research groups. Thus the principals of the new company would have the opportunity to establish their own personal networks for help, advice, and information.

The final product of the incubator would be a new company developed to a stage where it could attract financing from

venture capital, stock market, or many other sources. It would have completed a practical and realistic business plan, complete with a viable product and marketing concept. It would possess a demonstratable production prototype of a marketable product. It would have recruited and developed a complete and qualified management team.

KEY SUCCESS FACTORS

The most important is leadership. The management and Advisory Board of the incubator must be prepared to lead not only the new entrepreneurs in the incubator, but also the university and business communities in linking entrepreneurship to university research. What happens in the incubator will be dependent upon the sense of mission, communications skills, and character of its management.

The intellectual climate in the university community is probably the second most important factor in determining the structure and shaping the success of the incubator. The strength of a new technology based enterprise depends to a large extent on the quality of its technology, and in turn on the quality and significance of the university research involved. The effort of creating a company should not be wasted on second-rate research, or on developments with insufficient lead time to establish the product.

The breadth of instruction in the university is important because the best product ideas are likely to arise from the cracklines between disciplines. Hence a broader knowledge of many fields and technologies is essential. University programs that emphasize interdisciplinary communication and discussion will be high-potential sources for the new concepts and the creative individuals needed for new enterprises.

In order to develop the areas in the university which might form the bases for new enterprises, it is important that the university itself have a clear mission. Supporting applied research for its economic benefits does not mean the prostitution of intellectual enquiry. On the contrary, steeples of excellence in pure research often kindle the spark of intuition for applied product ideas.

The principal task of an incubator is to help people grow in knowledge, intellect, character, and confidence. The incubator helps to make entrepreneurs with science knowledge out of scientists with entrepreneurial inclinations. This task is easier if the university already places great emphasis on the personal development of students.

Ideas, concepts, and inventions are the raw material of new technological enterprises. University policy regarding the ownership of intellectual property developed by individuals on campus must not stifle the motivation for its commercial

development. The university has considerable potential to gain from an enlightened and aggressive strategy which encourages entrepreneurial development of new ideas. The greatest financial returns to the university may in fact come not from royalties but from voluntary donations that are motivated by the gratitude and attachment that a wise university instilled in its graduates.

Most advanced research ideas result from close collaboration between students and faculty in the university, so new enterprises would often involve both. This will be most successful if faculty are not restricted in their activities (provided they carry out their obligations to the university). Faculty teaching will benefit greatly from exposure to commercial applications in their field of interest.

To achieve "critical mass" in a UBBI, it must be based on a university or a faculty that is sufficiently large and broad enough to provide an adequate supply of high quality ideas and people. Within the university, we look first to the areas of particular research strength. An incubator strategy can then be built around these areas until an adequate group can be identified.

Finally, the incubator provides to the university a new option for post degree education. Instead of a thesis, the incubator graduate has developed a product and a company; instead of looking for a job, he has created one for himself and likely job opportunities for others as well. The incubator provides a wide range of new opportunities to students and faculty, and a new means of communication with the community.

ORGANIZATION OF A UBBI

An incubator should be limited in size. To be effective, it must be large enough to reach critical mass in terms of enthusiasm, motivation, and communication, yet not too large for effectiveness. It must be large enough for economical operation of common services, yet not so large that the incubator itself is hard to manage. Presently, we feel a maximum size would accommodate ten start-up companies and an incubator staff of five in a facility of about 10,000 square feet at an annual cost of $4-500,000.

Some degree of technological specialization is probably appropriate. This will occur naturally if the incubator is based on a related group of university programs. Prototyping for different disciplines may require incompatible facilities (for example, the biological sciences and mechanical engineering).

The funding for a UBBI logically comes from a partnership of public and private sources. A suitable structure would see the facilities and educational elements publicly funded while the embryo companies were privately funded. This gives a clear relationship and makes the new companies attractive enough to

investors so that seed financing can be obtained while the companies are still in the incubator. The new companies would, of course, pay rent for space and charges for common services.

We have proposed that the public entity be organized as a foundation, with members and Board consisting of individuals drawn from both the business and university communities.

The incubator should be independent of the university administration. It would be difficult to extend university policies and decisionmaking mechanisms to cover the incubator operation. Similarly, its location should be distinctly separate from the university laboratories, in order to emphasize to the new entrepreneurs the difference in research purpose, to preserve commercial confidentiality where required, and to avoid conflict of interest situations.

IMPLICATIONS FOR SCIENCE POLICY

The process of Technology Transfer is recognized as a key point in realizing economic benefits from scientific research. However, technology is often lost in the transfer process, through imperfect communication or through the lack of any enterprise to which new technology can be transferred.

The UBBI provides an extremely effective means of transfer, particularly for new or emerging technologies. At relatively low cost, it can provide a dramatic improvement in the survival rate of ideas from concept to commercial implementation. It is a high leverage tool of economic development.

The best means of transferring technology is often to transfer the people who possess the knowledge. This is particularly effective when this process is accomplished in an exciting, highly motivated atmosphere in which the new enterprise has a high chance of success.

This situation maximizes the opportunity for scientists to commercially benefit from their discoveries. It provides new flexibilities in the scientific career path which will encourage more students to choose applied research as their initial career.

The University Based Business Incubator is a very highly leveraged tool for economic development, particularly in the development of new technological industry. It accelerates the benefits and reduces the failure rate of new enterprises; it ensures that promising lines of research lead to practical results; it provides new and exciting opportunities for our university graduates. In a science policy that places new emphasis on the public benefits resulting from university research, UBBIs must play a vital role.

BULLETIN

Aerospace Industries Association of Canada / Association des Industries aérospatiales du Canada

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DOCUMENT: 830-220/035

DISCUSSION PAPER

CANADIAN FORUM ON
A NATIONAL SCIENCE AND TECHNOLOGY POLICY
FORT GARRY HOTEL, WINNIPEG, MANITOBA
8-10 JUNE 1986

SUBMITTED BY THE

AEROSPACE INDUSTRIES ASSOCIATION OF CANADA

AIAC

DISCUSSION PAPER

CANADIAN FORUM ON
A NATIONAL SCIENCE AND TECHNOLOGY POLICY
WINNIPEG, MANITOBA - 8-10 JUNE 1986

SUBMITTED BY THE
AEROSPACE INDUSTRIES ASSOCIATION OF CANADA

The Aerospace Industries Association of Canada is pleased to submit the following for discussion at the June 8-10, 1986 Forum on Science and Technology in Winnipeg.

First we would like to note that our Industry has invested considerable resources over the years on many conferences, symposia, debates, discussions and papers intended to develop, establish and implement a national policy on Science and Technology, or, in other words, a national strategy for Research & Development.

At each of these events the same problems are aired and, essentially, the same conclusions drawn. Unfortunately, very few changes are apparent despite the effort. For instance, one of the problems always tackled is the low proportion of the economy of Canada which is devoted to Research and Development. This is, no doubt, the most important aspect of the whole question. So what has happened? Amongst the significant 8 OECD countries, Canada was ranked 8th in 1963 and has remained so in all of the subsequent years. In 1963 Canada spent 1% of its GDP on R & D. This rose to a "high" of 1.35% in 1971 and is now back to an approximate 1.25%. (Still lowest amongst the OECD countries and less than half of what our major competitors spend). And no amount of philosophising has, apparently, changed that basic problem.

The AIAC had great difficulty in coming to grips with the broad range of questions posed by the Minister in the short time available. In general, we would recommend that it is time that a Royal Commission or very high ranking Task Force be organized to develop solutions to Canada's R & D problems.

This is not to say that our Industry is shying away from these difficult questions. We are unanimous in our support of the "Canada Forum on Science and Technology Policy" and as in the past, we are very keen to participate in tackling this broad subject. Our regret is that we have had to approach the proposed topics for discussion with a tremendous lack of information and from a rather narrow perspective. For example, we do not have details on the priorities, objectives, funding and expertise of either the many government labs or universities that conduct R & D. And more important we are not familiar with their mandates for working in co-operation with Industry.

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Nevertheless, a number of AIAC's members deal extensively with universities and government labs on specific projects. We work together in forecasting our long term skill and training requirements and most of us have spent a good part of our lives in the university and Government Lab environments. We have looked at these policy and strategic issues only on an occasional basis; and rightly or wrongly, only when we had a business interest at hand.

With these introductory comments in mind please accept the following general and specific comments and recommendations related to the questions posed in the background information package on the Forum.

General

The dialogue and the programs which exist between Industry and universities within Canada have not and are still not working as well as we would hope. This is in spite of considerable efforts in recent years to effect greater ties. Most of these efforts have been initiated by Governments at both the federal and provincial levels.

A review of these objectives is in order. The technology time frame for Industry is generally, at the most, 5 years into the future (and often considerably less). The University's time frame for the application of technology is 15 to 20 years and more.

The approaches to technology acquisition are entirely different for Industry and University. Industry must be profit oriented and will therefore accept solutions to its problems that are not entirely rigorous in a mathematical sense. Universities on the other hand have a natural desire to search for rigorous solutions that have broad application.

We do not disagree with these objectives for either group but question how a constructive dialogue between the two can occur when the objectives of both parties are so different.

Government laboratories, on the other hand, more closely focus their research efforts (in time) and attempt to direct these to specific needs. It is, nevertheless, hard to maintain a 'state of the art' position when the problems are not theirs and don't present themselves every day. Government departments that do have a specific mission other than maintaining a state of readiness (i.e., DND) must be responsible for their actions and by necessity must be tuned into likely solutions.

An R & D program must be national in scope. Specialization has been the key to success in the Aerospace field and unnecessary duplication of effort and capability in various regions of Canada has been, for the most part, avoided. Although it has not been as good as we believe it should be, communication within the Industry and through Federal Government Departments and programs has been working for years and remains essential. However, if the Federal government, provincial governments, universities, government labs and various R & D

establishments all want to be involved in R & D related to our Industry it is most uneconomical for each party to think, or attempt to be "ready and willing" to "take on any task". These comments are heard far too often and only proves the lack of communication and integration of our scarce R & D resources in Canada. If we are to tap our full capacity and potential we must work together to more common goals in the future than we have in the past.

University Research

Universities and University researchers still largely cling to the belief that basic research cannot be closely managed and that researchers, since they do not know what they might discover, must be free to chart their own paths and follow their own inclinations. Researchers must, however, appreciate that industry cannot be expected to fund such basic and undirected research. In our view, this leads to duplication and waste of effort. The argument that since such research is part of the educational process, such duplication is tolerable, if indeed not desirable, is a fallacy. The whole management process of the $1.5 billion of funds spent by Canadian Universities needs to be re-examined, particularly since less than half of that amount comes from University resources.

The traditional academic stance of the University researcher, who is not willing to recognize the commercial world's competitive pressures, though diminishing, is still highly prevalent. It will be necessary for those who provide the research funds to attach some realistic detailed and specific conditions to their use, even if that stifles some of the traditionally accepted academic freedoms. It has happened elsewhere and it will have to happen in Canada. In the U.S.A., for instance, Universities are involved in research activities which run counter to the various faculties' political inclinations but which are consistent with the country's national objectives. The allocation of funds provide the conditions. To be sure, the traditionally accepted academic freedoms might, thereby, become impaired.

The whole concept of Universities financing and grants allocation requires re-examination and re-adjustment. It has been said that basic knowledge is 10-20 years ahead of our ability to use it in the development and deployment of products and services. Indeed, a complete re-orientation of Universities' activities from Research towards Development would likely have the highly desirable consequence of bringing the Universities closer to the competitive marketplace, getting the Universities and industry together and, most importantly, bringing the educational process closer to the market demands. It also means that we will have to get away from that generally accepted idea that education "is a good and desirable thing per se" and admit that it be "education in preparation for doing something useful".

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University Research - cont'd

1. a) As it stands today, we believe Canada is not getting value for its money from university research. This is neither the fault of the university or of industry - the two are out of tune. This is a generalized statement of course, some universities do very well in the area, but, in general, university research is of little assistance to industry. The talent is there, the need is there, but the dialogue is not right.

   What is needed is more interaction between the two parties. We strongly recommend increased funding for university/industry seminars, the sponsoring of industry chairs at the universities and any other way to improve communication. This should be combined with a review of our Technology Base to identify both national strengths and long term needs. Incentives for joint industry/university R & D projects should be established - or if they are already in place they should be better advertised.

   b) New money should indeed be invested in the universities and, other priorities considered to support and encourage the above. It may be more practical however, to divert funds through the private sector for universities in order to stimulate closer cooperation in planning, R & D programs, and educational emphasis.

   c) See item 1. a) above.

   d) Industry needs to do more (and so must universities) to encourage the dialogue. Industries need to identify the universities in their field and ensure they are aware of their long term needs. At the same time emphasizing the 'Business' restrictions.

Government Laboratories:

2. a) Government Laboratories are most useful as long as they are participating in the process of developing products and services. Government Labs should have a properly integrated mission which should not be compromised by political considerations.

   If a laboratory needs to locate in a certain location to achieve its objective then such things as employment needs, etc. must take no place in the final analysis. If a department has a mission then any decision which hinders its long term goals is a wrong one. This is particularly true in DND. A buy off-the-shelf policy for example, which may satisfy today's needs, can do nothing but harm its long term needs.

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Government Laboratories - cont'd

Every department should have a 'mission' and should answer to the appropriate authority on how they are achieving their objectives. An objective that reads 'following the state of the art' is not adequate - they must be applying it or it should be dropped.

As soon as they pursue projects where knowledge is being acquired for knowledge's sake we should terminate the activities and withdraw funding.

We would agree that there is insufficient input from industry. In some cases Industry does not let the Laboratories know what is needed or expected of them, in some cases because they are not being asked and in other cases because industry does not come forward. In yet other cases Industry does not let the government decision makers know how useful and excellent the work of the Laboratories is and how successful the co-operation between the Laboratories and Industry has been. And there are many instances of the latter.

In general, the Laboratories and their personnel should be used in the Government administrative process associated with the evaluation of Industry R & D proposals for Government support and the assessment of projects' progress rather than the initiation and implementation of original Laboratories and intramural R & D projects. The usual objection that such an approach will deprive the Laboratory personnel of the expertise necessary for evaluating the quality of industry proposals and activities can be mitigated by an industry-laboratories personnel exchange program. Such a program should be implemented, in any event.

We are also of the view that Industry is certainly getting benefit from the Government Laboratories, whether this is maximized is a matter of question. Government labs often have a unique mission and are a national resource which could not economically be justified by any particular company. In aerospace we have our Defence Medical Research Establishment NAE Facilities and David Florida Labs - just to mention a few examples. The United States operates extensive facilities through NASA, FAA and the Department of Defense in similar areas despite the fact that its industry is many times our size.

Government departments that do provide expertise or capital facilities should be fostered. These are a national asset and AIAC deplores any moves that would necessitate alternate measures.

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Government Laboratories - cont'd

We would further recommend the re-establishment of Government/Industry Advisory Groups to complement Management's efforts to devise programs and priorities.

b) National assets must be maintained but no funds should be assigned to the maintenance of out-dated technology.

c) Industry is satisfied with the "day-to-day" working relationship of Government Lab/Industry. This does not mean to suggest that it could not be improved. Government labs that are there to satisfy a specific mission must constantly call on the services of the appropriate sector of Industry or the expertise will rapidly dwindle, as has been the case in the defence sector. Also, all Government Labs must justify their existence. To only maintain a state of readiness is not sufficient.

International Science and Technology Developments:

3. It has often been said, and rightly so, that Canada should not be expending funds on Research or Development of technologies which it can "buy". But with buying or the importation of technology goes the importation of people. Manpower and Immigration Canada will have to re-orient its thinking if that is to become a reality. The current policy of having to prove un-availability in Canada, is in this respect, counterproductive.

We would agree that Canada should be attending International Seminars, Trade Shows and Exhibitions since this kind of intelligence is often unavailable from other sources. However, to make effective use there must be a proper system in place to disseminate the information to the users - whether it be universities, labs or the private sector. This activity should only be supported in these circumstances; otherwise it should not be supported by government funds.

Another dimension of this problem is our capability to share international technology. Do we rate; are we and our technology respected; have we technology that is pushing the future; is it of interest to other countries; and can we apply it to meet industrial needs both domestic and exports? The lack of R & D for many years has obviously led to a deterioration of our technology base - this is most vivid in the defence and transportation fields. In order to participate internationally we must invest in R & D with the same dedication as other nations, otherwise we relegate ourselves to a "lessor" nation and will not be able to benefit fully from international forums.

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In every case and regardless of which way we approached this question, the importance of having a strong system and programs in place at home in order to capitalize on foreign technology is an integral part of the answer.

In the aerospace sector 80% or more of our business is for exports and about 10-15% of sales over the years has been expended on R & D. In concert with the government we have recently developed consortia of both Canadian and Foreign companies to meet some of Canada's major national program requirements. This involves strong communication between domestic firms and optimizes the best technologies that we already have in Canada; it usually introduces key foreign technology where it is essential to make a system work; and it adds to our technology base by learning new technology, integrating the system and providing Life Cycle Support. This, in turn, will lead to a marketable product internationally. Often the choice of a foreign partner is key to international success.

These new large systems (and their future generations of products) provides major areas of initiative for all segments of the R & D community. Our national mistake is our belief that we can maintain our socio-economic norms and values by "brains and raw materials" alone - we try to ignore the fact that it takes financial investment and national commitment to make this happen.

Concentration in Strategic Areas of Science and Technology:

4. The past and current policy of concentrating our efforts in "Centres of Excellence" is sound and should be continued. It is true that it inevitably results in a degree of discontinuity and fragmentation, but so will any other strategy which recognizes that Canada cannot cover the whole of the spectrum. It is suggested that the concept be changed from "Centres of Excellence" to "Centres of Specialization". Excellence implies to be first and best. There is much precedent for being second but most successful. The "Excellence" concept causes potentially successful projects not to be considered or to be rejected because "somebody else has it already".

   The Japanese have proven that is is possible to design and sell a "better mouse-trap" and this can also lead to success.

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Government Involvement in Technology Assessment

5. One of our basic issues is "who decides what areas of specialization should be pursued? Our experience is that Industry is closest to the marketplace and should have a prominent role in deciding on technologies to be pursued. Clearly the closer the links between the various R & D performers in Canada the better we will be able to fully take into account the technology that is available or can be developed.

   Ultimately the marketplace will determine who can make "the best use of the available Technology". The problem is that this takes time, evaluation and assessment. We have found it counterproductive for everyone to be doing the same type of evaluation without proper communication of the results. Our Industry has been plagued by independent reviews by unqualified groups which have been given more creditability than a company's assessment - one which is funded by a company who is profit motivated. Industry, once established and mature does not expend its resources without a reasonable expectation of a return. This important fact is often ignored or considered in low regard.

6. Industry must be trained to realize that, if they are in business for the long term, they need the universities and must therefore invest in linkages with universities.

   One way to make our dollar go farther is to embark on more shared cost developments with universities and labs. The Industry's share should be related to the time it takes for new technologies to reach the marketplace.

Government Involvement in Advanced Technology Promotion and Utilization:

7. Government procurement of indigenous Canadian high technology products is the most potent force in the promotion and utilization of Canadian developed technology. The procurement of "off-the-shelf" high technology products from abroad and the conventional negotiation of compensatory industrial benefits packages is counter-productive.

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8. Provincial Governments Involvement in Research and Development:

The provincial governments involvement is uneconomical, the associated administrative processes are wasteful and it represents an unnecessary diffusion of resources. The involvement of provincial governments in R & D should, therefore, be eliminated. The provinces' total R & D expenditures represent less than 7% of the total national R & D expenditures and the provincial governments perform less than 3% of the R & D performed in Canada. All in all, the provincial contribution is just not big enough to be significant and should be diverted to more appropriate fields of endeavour or, better still, returned to the tax-payer. The involvement of additional levels of Governments and the consequent constant requirement for co-ordination and negotiation saps our strength and uses valuable resources. Inversely, the elimination of one or more levels of administration in the management of the national R & D effort would bring about economies.

9. We firmly believe that the public is capable of taking technology change in their stride but it needs broad support from senior levels. The focus among politicians in particular must be on the positive attributes and long term needs, rather than short term incidences that quickly can be manipulated for public attention. That does not mean to say there is not hardship in job loss and retraining etc. in taking short term action. However, in the long term we suggest that with the proper introduction, at the "kindergarden level", everyone will accept the technology change that confronts all of us.

The very fact that people must be retrained infers that they were not trained properly in the first place. The training should be directed to the fact that training is to become a continuous thing and has a purpose.

10. Regional Distribution of Research and Development Activities:

Equitable regional distribution of R & D activity is a myth and we should not attempt to pursue it. We should recognize that certain parts of the country will be suitable to certain activities and not for others. Competitiveness is created by clustering. There is nothing unusual about this. For example, California which represents less than 10% of the U.S.A. population contains 50% of the U.S.A. aerospace industry. Similarly, the high technology electronics industry is clustered around Boston and in Northern California. We in Canada cannot allow a peculiarly Canadian political problem stand in the way of technological progress. We should allow for concentration where it proves to be most successful. In the end everybody will be a winner.

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11. No Comment.

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13. No specific additional comments.

Communication has been lacking and must be stimulated, encouraged and funded if necessary. We are not in a position to make specific recommendations but look forward to lively discussions at the Forum.

14. Other Comments:

The brain drain occurs when there are insufficient opportunities for highly educated researchers in Canada. This is caused by two phenomena. The first is the fact that we do not spend sufficient funds on R & D in Canada, compared to other countries. The second is that we are overeducating in many sectors, both in quantity and quality, without any coordination with what we, as a country, need. Without such coordination we will always, as we do now, be spending inordinately high amounts of money for educating people whose skills we will subsequently be unable to utilize. This lack of coordination is caused by the Universities' apparent unwillingness to listen and to industries' inability to articulate its plans. There are unique exceptions to this which could be identified and used as a model for other sectors.

As mentioned elsewhere, provincial research organizations, which, in any event, represent only 2-3% of Canada's R & D effort, should be phased out. We suspect nobody, from a results point of view, will notice their disappearance and at least one step in the R & D administrative quagmire would thereby be eliminated.

We believe that there is a feeling in most Governmental circles that industry does not provide sufficent funds for R & D and that, specifically, industry does not fund a high enough percentage of the GERD. In 1985 Business Enterprises in Canada spent 39.3% of the GERD, whereas the Federal Government spent only 35.8% of the GERD. Perhaps, more importantly, the Federal Government spent 65% of its R & D funds intramurally and the private sector funds 82% of its R & D effort from internal resources. Indeed less than 10% of the Industry R & D expenditures are funded by the Federal Government. That, in fact, is the crux of Canada's R & D problem and no amount of coaxing or cajoling industry into spending more will fix our problems. The fact is that the motivator to the private sector is profit. So industry will do what makes sense to industry. The enigma is that it is a historical fact that industry's research and engineering staffs remain relatively constant through good times and bad. This is largely caused by the fact that the same personnel are, essentially, utilized for the development phase of a project and are subsequently utilized for support to production, product improvement and after-sales engineering service. Consequently, in good times, when R & D funds are available the staff are not available because of other commitments and in bad times, when the staff are available the funding is not. One of the ways to alleviate this problem might be to change the tax laws to allow companies to accumulate unspent R & D funds for future expenditures.

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CONCLUSION:

The Canadian Aerospace Industry is, by Canadian standards, a very heavy investor and performer of R & D - 10%-15% of sales. Yet, major competitors in other countries are able to double this amount largely by government funded defence and space programs. In comparing our industry's R & D investment to foreign competitors as a percentage of sales or percentage of profit, we are on par. Although the level of R & D needs may vary between sectors (technologies) we would expect that a number of other industry groups in Canada experience this same frustration.

This leads to the conclusion that the basic problem we in Canada have is that we, as a nation, do not spend sufficient funds on R & D. To be on par with the rest of the world will mean an increase in GERD of approximately 50%, and, except for some potential but relatively minor adjustments this increase must be from the Federal Government. Such an increase would have to be in the order of $3 Billion annually and it should all be allocated to industry. If we do less we shall be sitting here next year and the year after and the year after that re-hashing the same problem.

DOCUMENT: 830-220/036

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Input to the Federal/Provincial Science Policy Conference

National Research Council of Canada

June 8-10, 1986
Winnipeg, Manitoba

National Research Council Canada
Conseil national de recherches Canada

President
Président

Ottawa, Canada
K1A 0R6

File Référence

04 June 1986

The Honourable Frank Oberle, P.C., M.P.
Minister of State for Science and Technology
C.D. Howe Building
235 Queen Street
Ottawa, Ontario
K1A 1A1

Dear Minister:

At a recent meeting you stated that you would be interested in having input from Council Members for the meeting on a National Science Policy which you are convening in Winnipeg June 10th.

The matter was discussed at a meeting of the new Science and Technology Policy Committee of Council last week. The Committee also met with the 30 chairmen of NRC's Associate and Advisory Committees. It is the first time that we have convened the Chairmen to discuss other than their particular mandate responsibilities.

I enclose a summary of recommendations, containing a number of points which Members hoped would be useful to you as background for the meeting with your provincial colleagues. I wish to emphasize that the 35 people involved happen to constitute as distinguished a group of science and engineering-related people as we are likely to find. Recognizing this, NRC intends to consult the Associate and Advisory Committee Chairmen as a group more frequently.

The Chairmen also came to a consensus on matters concerning NRC which they wished to have relayed to you, but which I consider not suited to a federal-provincial policy discussion. They are:

a) that the NRC plan "A Practical Perspective" addresses most of their concerns as far as NRC participation is concerned;

b) that the IRAP program is the most effective Federal instrument for technology transfer;

c) that important to this is NRC's program of basic research.

Naturally we are gratified by these unsolicited opinions.

Canada

I wish to thank you for consulting the Council. This will begin to allay growing concern on the part of Members that their work as Governor-in-Council appointees is not of significant importance.

Yours faithfully,

Larkin Kerwin

Encl.

INPUT TO THE FEDERAL/PROVINCIAL SCIENCE POLICY CONFERENCE

The Science and Technology Policy Committee met with the Chairmen of NRC's Associate and Advisory Committees on May 26, 1986. Following the discussion it became appparent that the following issues were considered to be of primary concern.

Technology Transfer

Canada needs to improve and make more effective a coordinated technology transfer process for the communication of known knowledge and the dissemination and utilization of existing information. It is not enough to develop technology and have it available. The communication of R&D results to users must be an active process for both researchers and users and not left to chance. In addition, Canadian researchers must be aware of foreign research developments and incorporate them in their own R&D efforts.

Public Awareness and Public Opinion

The level of scientific and technological literacy in the general population, as well as in those parts of industry outside R&D units, needs to be raised. Scientific R&D is not seen as a priority outside the research community and it is questionable if the Canadian population is generally supportive of the Canadian research effort. There is a need to develop a program to inform the public, to make them more sensitive to national needs for research and to present the benefits of R&D.

Mechanisms for the Enhancement of R&D

Establishing priorities for emerging technologies may not be as important as identifying and developing mechanisms for enhancing the effectiveness of R&D in general. Canada must strive to provide a trained body of people prepared to deal with various types of industry or social priorities from a broad base of generic research; we must develop a national capacity for change. The choice of strategic technologies should be made by those directly concerned with the development of industrial R&D capabilities, i.e. what is needed is entrepreneurial pull rather than policy push.

Basic and Generic Research

There is a continuing need for a strong and long-term commitment to basic and generic research in Canada. Basic research provides not only the source of new ideas, but the trained manpower needed to fuel the development and application of technology. Although we must increase the amount of effective applied and goal-oriented research carried out in Canada, we must be careful not to erode the essential core of basic research.

R&D Priority Setting

While it is recognized that there are difficulties in government agencies setting specific R&D priorities and that such priorities tend to become out-of-date quickly, Canada must identify those generic areas in which it will concentrate its efforts now and in the future. We cannot be "all things to all people"; we must use what we have efficiently and minimize the diffusion of our limited resources.

Most recent studies have concluded that the three most important technological areas for Canada are biotechnology, advanced materials and information technology. It is necessary, however, to decide on more specific subjects within these broad generic areas.

Promising new technologies which are identified should be tested against suitable criteria, e.g. they must be of a size appropriate to Canada and within our capacity, with a Canadian relevance (need or use) and with a proven competence in existing or readily available expertise. An NRC Committee is now considering such criteria.

DOCUMENT: 830-220/037

Submission

to the

"CANADIAN FORUM NATIONAL SCIENCE AND TECHNOLOGY POLICY"

June 8-10, 1986

Winnipeg, Manitoba

from

The National Executive of

WOMEN IN SCIENCE and ENGINEERING/FEMMES en SCIENCES et en GENIE
(WISE/FSG)

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WISE/FSG is a national association of Canadian professional women, who are actively involved in engineering and the applied sciences. Among the objectives of WISE/FSG are the promotion of engineering and technology, and the advancement of excellence in research and technical development.

Through its many Chapters across the country, members of WISE/FSG make it their business to visit schools and meet with students and their teachers, and they stress the importance of technical literacy for ordinary citizens. Members of our organization provide role models for young women, demonstrating that scientific and technical careers are suitable for women.

Section 2.4 of our Constitution states, in part, that the "objectives of WISE/FSG are:

a) To encourage women in Canada to enter careers in engineering, mathematical and natural sciences.

b) To encourage women in Canada to attain high levels of educational and professional achievement in engineering, mathematical and natural sciences.

c) To serve as an information centre for and about Canadian women in engineering, mathematics and natural sciences."

In our effort to meet these objectives, our members have been very much aware of the difficulties caused by the lack of long range, national science and technology policies. We welcome, therefore, the initiative taken by the Government and look forward to the discussions of all the invited delegates at the Winnipeg Forum.

The draft copy of the Forum's Background Paper raises a wide range of issues, and the three suggested topics,

" A National Science and Technology Policy: The Development and Acquisition of New Knowledge"

" A National Science and Technology Policy: Putting Knowledge to Work and Realizing Opportunities"

" A National Science and Technology Policy: Involving All Canadians and Adapting to Change"

no doubt, will provide focus for the many comments from other invited constituencies. It seems to us that a strong statement of purpose will have to emerge from the discussions of these topics, transcending political expediency.

The federal government pledged to expand the employment opportunities of all Canadians. We believe that women will continue to participate in the labour force in proportion to their numbers in the total population, therefore it is vitally important that they be expected to enlarge not just the 'employee', but the 'employer' sectors of the economy; they must be among the managers not just the managed.

Knowledge and information will be the most valued "products" for sale in the 'Information Society'. In order to realize the highest level of GNP, Canada cannot afford to use only half of its citizens' brain power.

WISE/FSG members are practicing scientists and professional engineers. They are occupy positions in all three sectors of the economy: industry, labour, and government. Their views, as active participants in the advancement of science and technology, will also be represented in the many briefs that the Minister of State and Technology will receive from other delegates. In this paper, we propose to address issues that fall directly within the mandate of WISE/FSG.

EDUCATION - THE KEY TO THE DEVELOPMENT AND ACQUISITION OF NEW KNOWLEDGE.

While research and develooment (R&D), and technology transfer are important elements in the search for new knowledge, the basic question should also be raised about a nation's ability to acquire knowledge, as it manifests itself in its citizens' level and quality of education.

Education seems to us to be one of the most important contributors to ability to acquire and apply (new) knowledge. Those nations that showed spectacular economic recovery, after the almost total devastations of the World Wars of this century, had excellent schools and a comprehensive educational system. Germany, Japan and some of the eastern European industrial nations, have been able to rely on their "native" brain power without significant help from "immigrant" scientific and technological expertise. They learned fast, adapted and adopted with relative ease, and again became significant players on the international scene.

The sudden emphasis on education, particularly scientific education, in the United States of America after the 1957 Sputnic crisis underscores this point.

We believe that Canada, in order that it can realize a national science and technology policy, must have a national educational policy. That policy must contain the expectation that Canadian men and women will equally participate, to the best of their ability, in all aspects of higher learning. In addition, that policy must call for an increased level of scientific and technical literacy among the whole population, but particularly among those who seek post secondary education on university level.

At present, science and mathematics courses are optional in all high school curriculum beyond the intermediate level. At the universities and in the colleges, engineering and science faculties require that their students take courses in the humanities, however, the reverse is not true. This narrow, utalitarian outlook on the use of mathematics and sciences tend to lower the cultural background of university or college bound students.

Students of lower academic achievements are advised to drop the courses that require communication skills. They are still encouraged to take technical subjects, in order to graduate from high school, assuming that they will enter a trade after graduating.

These two approaches do not seem to be compatible with the requirements of the present day economic reality. In the era that is characterized as the 'information society', every effort must be made by the schools, on every appropriate level, to provide students with the widest range of information, throughout their years of study. Specifically, we believe that, in order that we prosper as a nation, a national commitment is required to science and technology - from basic research in university laboratories to every product we manufacture and every service we provide.

SCIENCE EDUCATION SHOULD BE COMPULSORY THROUGHOUT THE YEARS OF HIGH SCHOOL, and upper level credits in science and mathematics should be among all university programs' entrance requirements, except for those which lead to the visual or performing arts.

THE DELIVERY OF THE SCIENCE AND MATHEMATICS COURSES, IN HIGH SCHOOL, SHOULD ENSURE THAT STUDENTS APPRECIATE THE USEFULNESS OF THESE SUBJECTS IN THE EVERYDAY LIFE OF ORDINARY PEOPLE.

Such an educational policy, we contend, would ensure a greater pool of informed citizens, who would be better prepared to develop and acquire new knowledge, whatever is their occupation. In addition, such a policy would also ensure that young women would maintain participation in the science and mathematics courses throughout their studies in high school. At present, young people, especially women, tend to neglect the sciences and mathematics courses after grade 10, unless they are ready to declare their interest in occupations, such as engineering. YOUNG WOMEN, IN THEIR TEENS, FIND IT DIFFICULT TO MAINTAIN AN INTEREST IN THE SCIENCE AND MATHEMATICAL SUBJECT, IF THAT INTEREST GOES AGAINST PEER PRESSURE.

Young people need role models. Prominent men and women of science and technical achievement should be featured in the literature and history curriculum. MORE WOMEN TEACHERS ARE A MUST IN THE SCIENCE DEPARTMENTS OF THE SCHOOLS AND THE SCIENCE AND ENGINEERING OR TECHNOLOGY FACULTIES OF OUR POST SECONDARY INSTITUTIONS.

The biases that our young people learn are rooted in our schools. If our government believes that science and technology is vital to the prosperity of the nation, then it must provide the necessary leadership in that direction. In Britain and Japan, the prime minister's office is directly involved with science and technology, and in Sweden innovation is overseen by the deputy prime minister. A COMMITMENT TO THE ADVANCEMENT OF SCIENCE AND TECHNOLOGY, SUPPORTED BY AN EDUCATIONAL POLICY, IS REQUIRED FROM THE GOVERNMENTS OF CANADA.

At present, there is only one women to every eight men (1:8)

entering engineering. Hardly any women engineers stay to complete graduate studies, due to the opportunities in industry and lack of encouragement from the post secondary institutions. UNIVERSITY CALENDARS, WHILE NOT DISCOURAGING, CERTAINLY DO NOT ACTIVELY PROMOTE SCIENCE AND ENGINEERING ENOUGH, AMONG FEMALE STUDENTS. Women faculty members do not get the number of research grants or administrative and management positions they deserve on the basis of merit. Examples such as WISH (Women Into Science Hopefully) at York University should be publicized by the governments.

IN SUMMARY, CANADA NEEDS AN EDUCATIONAL POLICY WHICH RECOGNIZES THAT SCIENCE AND TECHNOLOGY IS ESSENTIAL TO THE SURVIVAL OF OUR ECONOMY AND ENSURES THE PARTICIPATION OF THE BRIGHTEST MINDS - BOTH MEN AND WOMEN OF THE COUNTRY - IN THE ACQUISITION AND DEVELOPMENT OF (NEW) KNOWLEDGE.

EDUCATION IN RELATION TO RESEARCH AND DEVELOPMENT.

Many members of WISE/FSG work in research and development. Their place of work may be at the universities, crown corporations, private or government laboratories, or private corporations.

It has been observed that technology transfer, in Canada, is well utilized. For instance, community colleges of applied arts and technology play a significant role in 'putting new knowledge to work'. These institutions benefit from the close ties they have developed with business and industry. They continuously monitor the relevance of their training through a variety of cooperative educational programs, and by the placement record of their graduates. The teaching faculty has relevant industrial experience. They proved that their kind of educational institutions can rapidly utilize high - tech. equipment in re-training and undergraduate programs, when funding was provided for them through BILD and the Innovation Centres, in Ontario.

It may be argued, however, that neither the colleges, nor the universities get the kind of long term direction and fiscal support from governments that would allow them to do an excellent job in research and development, AND teaching, on an ongoing basis. Senior science and technology officials warned, for some time, that Canada is loosing students and bright people, because they do not see opportunities in Canada. The number of scientists and engineers working in R&D, for each 100,000 people in the work force, is less then half of that in the US: about 23 in Canada, over 58 in the US, 37 in the Netherlands and 66 in Japan! The percentage of the GNP devoted to R&D in Canada is very low, as compared to other industrialized nations.

We, in Canada, have been asking from its universities more then they can deliver. The universities were expected to solve the youth unemployment crisis of the 'Big Generation', its faculty members must publish-or-perish, they are expected to find the funds for badly needed, new, equipment from business and industry, and they must be in the forefront of R&D, in order that they attract grants for research from private or government sources.

R&D funds tend to be scattered among large numbers of government and private laboratories, and universities. Uncertainty about the availability of these funds, frequent, arbitrary cut backs, and lack of strategy have been harmful to Canada's R&D performance. Canadian government-affiliated laboratories, which were established with a well defined goal, however, proved to be very succesful. Good examples include CRNL and WNRE, who produced the CANDU system in Canada.

For greater effectiveness, appropriate grant policies should focus the country's research and development goals and activities. Establishing priorities for the distribution of the R&D funds is definitely a key point to a successful strategy. Priority should be given to research in areas of Canada's existing and unique strengths, such as oceanography, food irradiation, pollution control, oil sands, agricultural technology, telecommunication and nuclear technology, just to list a few. A multitude of private and government research establishments are recommended, with careful allocation of their mandate and their R&D funding. These RESEARCH INSTITUTIONS SHOULD BE LOCATED IN THE APPROPRIATE REGIONS OF THE COUNTRY, PROVIDING EMPLOYMENT AND INDUSTRIAL OPPORTUNITIES IN THE AREAS MOST DIRECTLY ASSOCIATED WITH THE APPLICATION OF THE NEW KNOWLEDGE AND TECHNOLOGY.

IT IS RECOMMENDED THAT THE UNIVERSITIES BE ALLOWED TO CONCENTRATE ON BEING THE CENTRES OF EXCELLENCE IN TEACHING, and in the advancement of higher learning. They should concentrate on the improvement of the quality and method of teaching.

Our university graduates must be technically competent and the post graduates highly specialized, in order that we can develop a new economy based on advanced technology. POST GRADUATE PROJECTS AT THE UNIVERSITIES SHOULD SUPPORT THE UNDERTAKINGS OF THE SPECIALIZED RESEARCH INSTITUTES, AND TRAIN HIGHLY QUALIFIED CANDIDATES FOR THE INDUSTRIAL AND DEVELOPMENTAL SECTORS OF THE ECONOMY.

In order to achieve that, OUR UNIVERSITY PROFESSORS MUST HAVE THE FREEDOM TO CONCENTRATE ON THEIR PRIMARY ROLE, WHICH IS TO FACILITATE THE LEARNING OF THEIR STUDENTS.

Special research institutes or agencies should have the mandate to bridge the gap between universities and private industry, and get new ideas into commercial use. University professors should have a chance to do research at these institutes, but THE MAIN CRITERION FOR CHOSING A LECTURER SHOULD BE HIS/HER ABILITY TO TEACH.

IN SUMMARY, BY INCREASING THE NUMBER OF MEN AND WOMEN, WHO ARE INVOLVED IN THE DEVELOPMENT, TRANSFERRING AND USE OF NEW KNOWLEDGE, COUPLED WITH THE INCREASED PERCENTAGE OF THE GNP DEVOTED TO R&D, CANADA WILL STAND A BETTER CHANCE IN PUTTING KNOWLEDGE TO WORK AND REALIZING OPPORTUNITIES.

EDUCATION IN RELATION TO INCREASED ABILITY TO CHANGE.

We believe that an education, well grounded in the sciences, is the most appropriate preparation for adapting to change, since it provides us, humans, with an understanding of ourselves and our needs in the physical reality of this planet. This understanding should not be limited to the male segment of our race.

Technology is "the knowledge and means used to produce the material necessities of a society". We cannot live without technology. Education and training in all levels of our schools must provide our students with the most relevant knowledge and technical background, to ensure our society's survival. Recent world events made all of us realize the finite dimensions of our globe, and the ecology's vulnerability to uncontrolled pollution. If ordinary citizens are more familiar with the consequences of the use of certain technologies, if they are not leaving everything to the 'experts', a democratic society is more likely to make the right choices.

Technology also means the most effective utilization of "knowledge that deals with the industrial arts and sciences". In Canada, a significant number of professional engineers are employed as technologist. At the same time, university professors are asked to compromise between research and teaching. If the trained citizenry's knowledge is not put to use through appropriate employment, the standard of living will suffer, and the economical viability of the country may be in danger.

We believe that A NATIONAL SCIENCE AND TECHNOLOGY POLICY MUST BE SUPPLEMENTED WITH AN APPROPRIATE NATIONAL EDUCATIONAL POLICY, AND A NATIONAL INDUSTRIAL STRATEGY.

IN ORDER TO BE PREPARED FOR CHANGE, EFFORTS SHOULD BE MADE BY THE GOVERNMENTS TO ENCOURAGE BOTH MEN AND WOMEN TO BECOME FAMILIAR WITH THE FUNDAMENTALS OF SCIENCES AND TECHNOLOGY. WISE/FSG CAN OFFER IDEAS, SUGGESTIONS, AND THROUGH ITS MEMBERSHIP ASSIST THE GOVERNMENT IN ACHIEVING THIS OBJECTIVE.

June, 1986.

WISE/FSG National
P.O. Box 6067,
Station A,
Toronto, Ontario.
M5W 1P5

The Honourable Frank Oberle,
Minister of State
for Science and Technology,
Canada

June, 1986.

Dear Mr. Oberle:

On behalf of the national organization of Women in Science and Engineering/Femmes en Sciences et en Genie (WISE/FSG) I wish to thank you for the invitation to attend the " Canadian Forum on a National Science and Technology Policy" in Winnipeg, on June 8-10, 1986, organized by your Ministry.

Please find attached the submission prepared on behalf of the national executive of WISE.

I look forward to meeting other participants and the discussions of the Forum's topics.

Yours truly,

M Kende

Margaret Kende, P. Eng.
Vice-President
WISE/FSG
National Executive

DOCUMENT: 830-220/038

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

<u>Statement for the Canadian Conference on the National Policy of Science and Technology</u>

Association des communicateurs scientifiques du Québec

June 8-10, 1986
Winnipeg, Manitoba

The purpose of the Association des communicateurs scientifiques du Québec is to provide opportunities for meetings and exchanges between professional scientific communicators and to promote scientific popularization. The Association's membership includes journalists, public relations people and organizers from both the public and private sectors.

Through its activities, the Association attempts to meet its members' needs for training, development and information. It also seeks to encourage thought on scientific communication practices, and to promote joint action by members and organizations belonging to the popular scientific community, notably by organizing conferences.

Scientific Popularization: A Necessity

Scientific knowledge and technical complexity are the bases of our society's development. They have also transformed our environment. Modern man is somewhat similar to primitive man: surrounded by mysterious phenomena, at the mercy of nature (or high priests), and so on.

From one day to the next, the tools we work with and even the most ordinary objects become more complex. The new and different world emerging around us threatens to become almost completely foreign to us. At the same time, our society must

accelerate the pace of change and create an environment conducive to it. Moreover, such an environment must be ready to accept, understand and steer the course of change, in order not to be its victim.

Despite cultural models which do not always enhance technical knowledge, the desire for knowledge exists, as demonstrated by a number of studies[1] and popular trends (such as computer sciences).

Scientific information circulates everywhere in every form. Too often, however, it exclusively targets a specialized, marginal, or English-speaking public. Or its chief purpose is dictated by marketing or public relations concerns. For this reason, the public was first "educated" about computers through the advertising of micro-computer manufacturers. Although that is not so bad, it is not enough.

To popularize something means to make it available to the greatest number of people. It means heightening awareness and informing. But it also means decoding, taking a critical approach to "the wonderland of science and technology". This approach harmonizes with certain democratic objectives. Sharing power (which is also scientific and technical) and involving the public in social debate (new forms of energy, pollution, the impact of technology on jobs) and decisions, require better means

[1] Tremblay-Roy Report, Ministère de l'Enseignement supérieur de la Science et de la Technologie du Québec, 1985, p. 222.

of disseminating information.

The Current Situation

In this respect, it would appear that the mass media are poorly equipped for the job. A study sponsored by the ACSQ[2] revealed that scientific news, with 3.1% of news space, ranks ninth in major newspapers -- far behind sports (26.4%), politics (15.6%) and the economy (10.6%). Worse yet, it captures only 0.44% of television broadcasting time. Thus, an enormous gap seems to exist between the news content of the mass media and the current scientific and technical reality.

This phenomenon is all the more puzzling given that it does not stem from the public's wishes. In a recent poll taken by the Quebec Federation of Journalists, in co-operation with the magazine L'Actualité, 97.7% of those surveyed said they would like to receive more scientific information.

Despite everything, the vitality of Quebec's popular scientific community surfaces outside the mainstream media in excellent magazines such as Forêt Conservation, Québec-Science, Science et technologie, Interface, Je me petit-débrouille, Franc-Nord, and La Puce à l'oreille, or in the efforts of the Hebdo-science press agency, which publishes books and a magazine in

2 La nouvelle scientifique dans la presse québécoise, Louise Boucher and Denise Dupuis under the supervision of Bernard Schiele, Association des communicateurs scientifiques du Québec, 1985.

addition to disseminating scientific information to radio stations and regional weeklies.

However, management of these undertakings is tenuous and depends heavily on volunteers. Government subsidies are meagre and fluctuating.

Solutions

The government already sponsors a program intended to heighten public awareness of science and technology which has played a crucial role in the development popular science.

Regrettably, the program's budget was reduced by one-half this year, to $600,000.

Government action, especially with regard to funding, should be re-evaluated according to several priorities:

1. The awareness program's budget should be significantly increased;
2. Funding established popular scientific organizations should take precedence over implementing every "good idea" suggested by organizations without experience in the field;
3. Applications from organizations that intend to gradually decrease their dependence on government support (through consultation and marketing) should take precedence.
4. Youth-oriented activities should be given priority;

5. Training and development activities, and activities aimed at increasing media awareness, should also take priority.

The ACSQ's Role

The ACSQ can play a leading role in organizing the popular scientific community. Its Forum of Scientific Information and Popularization Societies, which has already planned a number of joint marketing measures, could be a particularly useful intermediary.

The ACSQ can contribute to training and developing its members and, in co-operation with other organizations, foster greater awareness among journalists.

In May 1986, the ACSQ will hold an important international conference on scientific popularization. The conference, organized by two major universities with the help of several public and private sector organizations, will analyse the current state of scientific popularization and determine specific policy elements. Its goal thus coincides with that of the present forum.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

Mémoire pour la conférence canadienne sur la politique nationale des sciences et de la technologie

Association des communicateurs scientifiques du Québec

le 8-10 juin 1986
Winnipeg (Manitoba)

L'ASSOCIATION DES COMMUNICATEURS SCIENTIFIQUES DU QUEBEC

MEMOIRE

POUR LA CONFERENCE CANADIENNE SUR LA

POLITIQUE NATIONALE DES SCIENCES ET DE LA TECHNOLOGIE

Dominique de Pasquale,
Président

Montréal, le 23 mai 1986

L'Association des communicateurs scientifiques du Québec se veut un lieu de rencontres et d'échanges pour les professionnels de la communication scientifique, en même temps qu'un instrument de promotion de la vulgarisation scientifique. Elle regroupe des journalistes, des relationnistes et des animateurs qui oeuvrent tant dans le secteur public qu'au sein de l'entreprise privée.

Son programme d'activités répond à des besoins de formation, de perfectionnement et d'information de ses membres. De plus, elle s'efforce d'animer, notamment par la tenue de colloques, une certaine réflexion sur les pratiques de la communication scientifique et de favoriser la concertation entre les animateurs et les organismes du milieu de la vulgarisation scientifique.

La vulgarisation scientifique: une nécessité

La connaissance scientifique et la complexité technique sont au coeur du développement de notre société. D'autre part, les sciences et les techniques ont transformé notre environnement. L'Homme moderne se retrouve un peu dans la situation du primitif qui vivait, entouré de phénomènes mystérieux, à la merci des éléments... ou des grands prêtres!

Nos outils de travail, nos objets même les plus usuels se font chaque jour un peu plus complexes. Un monde nouveau, différent, naît autour de nous; il risque de nous devenir à peu près totalement étranger. En même temps, il y a, pour nos sociétés, la nécessité vitale d'accélérer encore le changement, de créer un milieu qui le stimule. Et il faut préparer ce milieu à accepter, à comprendre le changement et à le diriger, pour ne pas en être victime.

Or en dépit de modèles culturels qui ne valorisent pas toujours la connaissance technique, l'appétit de savoir existe. Certaines études[1], de même que certains engouements populaires (notamment pour l'informatique), le démontrent.

Et l'information scientifique circule, omniprésente, multiforme. Mais elle est trop souvent conçue pour des publics spécialisés, ou elle est marginale, ou elle est anglophone. Ou encore, elle répond principalement à des objectifs de mise en marché ou de relations publiques. C'est ainsi que le public a d'abord été "instruit" sur l'informatique par la publicité des fabricants de micro-ordinateurs. Ce qui n'est pas si mal mais insuffisant.

Vulgariser, c'est mettre à la disposition du plus grand nombre. Vrai. C'est sensibiliser, informer. Vrai. Mais c'est aussi décoder. Il s'agit ici de retrouver un certain esprit critique face au "monde merveilleux de la Science et de la Technique". Ce qui rejoint certains objectifs démocratiques. Partager le pouvoir (qui est aussi scientifique et technique), impliquer le public dans des débats sociaux (énergies nouvelles, pollution, emploi et technologie), l'associer à des choix, cela implique désormais une meilleure information scientifique et technique.

1- Rapport Tremblay-Roy, Ministère de l'Enseignement supérieur, de la Science et de la Technologie du Québec, 1985, 222 p.

La situation actuelle

A cet égard, les grands médias paraissent assumer bien mal leur mission. Une étude réalisée pour le compte de l'ACSQ[2] nous apprend que l'information scientifique, avec 3,1% de l'espace rédactionnel des grands quotidiens, vient au 9e rang, loin derrière les sports (26,4%), la politique (15,6%), l'économie (10,6%). Pire: à la télévision, elle occupe 0,44% du temps d'antenne. Il pourrait donc exister un fossé entre le contenu rédactionnel des grands médias et la réalité scientifique et technique du monde actuel.

Ce phénomène paraît d'autant plus surprenant qu'il ne peut s'expliquer par les attentes du public. En effet, un récent sondage, réalisé par la Fédération des journalistes du Québec en collaboration avec la revue Actualité, nous apprend que 97,7% des répondants souhaitent obtenir plus d'information scientifique.

Le milieu de la vulgarisation scientifique témoigne malgré tout, au Québec, d'une belle vitalité. Mais c'est en marge des "grands" que l'on trouve cette vitalité. On peut citer plusieurs excellentes revues, parmi lesquelles les plus importantes sont <u>Forêt Conservation</u>, <u>Québec-Science</u>, <u>Science et Technologie</u>, <u>Interface</u>, <u>Je me petit-débrouille</u>, <u>Franc-Nord</u> et <u>La Puce à l'Oreille</u>. Il faut aussi mentionner l'agence de presse <u>Hebdo-science</u> qui, en plus de diffuser de l'information scientifique à l'intention des hebdomadaires régionaux et des stations de radio, publie des livres et une revue.

Fragilité et bénévolat caractérisent pourtant la gestion de ces intéressantes entreprises qui se partagent les maigres et fluctuantes subventions gouvernementales.

2- <u>La nouvelle scientifique dans la presse québécoise</u>, Louise Boucher et Denise Dupuis sous la direction de Bernard Schiele, Association des communicateurs scientifiques du Québec, 1985.

Les solutions

Le Gouvernement dispose déjà du Programme de sensibilisation du public canadien aux sciences et à la technologie. Ce programme a certainement joué un rôle précieux dans le développement de la vulgarisation scientifique.

Il faut toutefois déplorer que ce budget a été, cette année, amputé de moitié pour être réduit à 600 000 dollars.

L'action gouvernementale, en particulier en ce qui concerne l'allocation des subventions, devrait être réévaluée en fonction de certaines priorités:

1- Le budget du Programme de sensibilisation devrait être haussé de façon significative;

2- Il conviendrait d'assurer d'abord le financement d'organismes reconnus dans le domaine de la vulgarisation scientifique plutôt que d'encourager la réalisation de toutes les "bonnes idées" en provenance d'organismes qui n'ont pas d'expertise dans le domaine;

3- Il y aurait avantage à privilégier les demandes d'aide visant à rendre les organismes progressivement moins dépendants des subventions gouvernementales (concertation et mise en marché);

4- Une priorité devrait être accordée aux activités orientées vers les jeunes;

5- Une autre priorité devrait être accordée aux activités de formation et de perfectionnement ainsi qu'aux activités destinées à sensibiliser les milieux journalistiques.

Le rôle de l'ACSQ

L'ACSQ peut certainement constituer un partenaire privilégié dans la mise en oeuvre d'une action structurante du milieu de la vulgarisation scientifique, notamment par l'intermédiaire de sa table de concertation des Organismes de vulgarisation et d'information scientifiques qui a prévu certaines opérations conjointes de mise en marché.

L'ACSQ peut contribuer à la formation et au perfectionnement de ses membres et, en collaborant avec d'autres organismes, à la sensibilisation des milieux journalistiques.

L'ACSQ tiendra, en mai 1986, un important colloque international sur la vulgarisation scientifique. Ce colloque, organisé en collaboration avec deux grandes universités et en liaison avec plusieurs organismes des secteurs public et privé, vise à faire le point sur la vulgarisation scientifique et à dégager précisément les éléments d'une politique, ce qui rejoint les objectifs de cette conférence.

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BUILDING ON
OUR
STRENGTHS

A Background Paper for the National Forum
on the National Science and Technology Policy
Winnipeg, June 1986

Prepared by the Ministry of State
for Science and Technology, Ottawa

May 26, 1986

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EXECUTIVE SUMMARY

This background paper for the National Forum provides a general overview of the major characteristics of the Canadian scientific and technological effort. It does so within the framework set last year by federal and provincial Ministers responsible for science and technology to establish a National Science and Technology Policy.

The paper assesses the major international and domestic forces that will help define Canada's thrust in science and technology. Among the international trends are the tendencies towards the internationalization of R&D and the focus by nations on concerted strategies for developing new technologies. On the domestic front, Canada is attempting to meet this challenge, but is faced with certain structural and institutional deficiencies. Among these are the weak private sector R&D infrastructure, and the fragmented science and technology base.

These matters suggest there is an urgent need for Canada to develop a cohesive approach to the new challenges and to define the objectives of a National Science and Technology Policy.

The paper then presents four themes that provide the agenda for discussing the parameters of a National Science and Technology Policy.

<u>The development and acquisition of new knowledge</u> is a theme that revolves largely around the role of universities in basic research and in the training of highly-qualified personnel. There is considerable evidence to suggest that the strength of our university system is weakening due to underfunding, growing obsolescence of the research infrastructure, aging of the research faculty, and threats of a brain drain of key, young scientists and engineers.

The federal laboratories, technology centres and provincial research organizations represent another critically important but fragmented source for acquiring and developing new knowledge. Canada has strengths in certain key technologies of strategic importance that will need further development and strengthened long-range national plans.

Putting this knowledge to work and realizing opportunities will require a special effort by the private sector: a sector that has certain structural features that make the task a daunting one. Governments have a critical role to play in providing an appropriate climate for investment in science and technology. This includes using procurement mechanisms to greater effect, encouraging foreign investment, promoting small business development, enhancing trade strategies, and optimizing the use of the Economic and Regional Development Agreements.

All of this requires a national ability to adapt to change effectively. Public awareness programs need to be enhanced, our young people must be better prepared through a strengthened science education system, and our work force must become better adapted to the effects of technological change. As the paper also points out, management has to increase its ability to understand and introduce new technology within the productive sector.

For each of the above three themes, the paper highlights some of Canada's strengths and opportunities in the area of science and technology. These include developments in the telecommunications and aerospace sectors, as well as the recent initiatives to bolster Canada's space program. New initiatives in science and technology are on the rise, particularly with the increased participation of provincial governments in formulating science and technology policy strategies and/or implementing new measures to strengthen industrial innovation and entrepreneurship.

Putting a national science and technology policy to work implies that:

- clear focal points must be created for a national technological effort and must involve a cooperative venture of all productive sectors of the economy;

- a solid basis for accumulating and transmitting knowledge and know-how must be put in place; and

- there must be an appropriate climate for innovation and entrepreneurship.

PREFACE

This document was prepared by the Ministry of State for Science and Technology to serve as background material for the National Forum to be held in Winnipeg, June 9-10, 1986, to discuss the development of a National Science and Technology Policy.

It is designed to give participants a quick overview of some of the key issues affecting science and technology development in Canada so that an informed debate can take place. As such, the paper does not provide any policy options or recommendations. It is recognized that some of the statistics used in the text can be queried; nevertheless the figures that are presented are those that have been generally accepted in representing the state of the nation's science and technology activities. Similarly, the reader should also be aware that the science and technology policy debate in Canada has had a long and somewhat checkered history. The Special Committee of the Senate on Science Policy of the late 60's and early 70's, as well as the work of the Science Council of Canada and the OECD helped set the early tone for this debate. Since then, many organizations, including the Economic Council of Canada, the Fraser Institute, the now defunct Canadian Institute for Economic Policy, and most recently, the Macdonald Royal Commission on the Economic Union and Development Prospects for Canada, have been quite active in stimulating national discussion on this vital issue from several - and sometimes quite different - perspectives. In addition, various provincial organizations and commissions have also made an important contribution.

The reader should also recognize that the use of the phrase science and technology throughout the text is merely a shorthand convenience; there are instances where institutional norms that apply to science (e.g. peer review) do not apply to technology, and vice versa.

Furthermore, the scope of the discussion regarding science and technology policy is deliberately broad, and quite often overlaps with industrial policy, foreign policy and the like.

The paper is premised on the commitment in February, 1985 by federal, provincial and territorial ministers responsible for science and technology to formulate a National Science and Technology Policy. The February ministerial meeting resulted in the identification of three strategic priorities. Governments agreed to:

1. Strengthen private sector investment in innovation;

2. Encourage the transfer and application of technology;

3. Support important basic research to develop longer-term scientific expertise and industrial leadership for the country.

The latter priority emerged as a major discussion point in a subsequent meeting of ministers at Meech Lake in September 1985.

For the purposes of building on the ministerial initiatives in Calgary (February 1985) and Meech Lake (September 1985), it was felt important to have a national discussion on a focussed set of issues that relate directly to the three strategic priorities agreed to by ministers. The result is this document which discusses the following key themes:

1. How to better develop and acquire new knowledge.

2. How to more effectively put this knowledge to work and realize opportunities.

3. How to ensure the involvement of all Canadians and fostering an ability for adapting to change.

4. How co-operatively to put a national policy to work.

There is a degree of overlap among these four themes, but they each draw together a number of important issues and are intended to assist the debate regarding a National Science and Technology Policy.

Subsequent to the Forum, the Minister, together with his ministerial colleagues from provincial governments and territories, will consider the input from this and other consultative mechanisms with a view to the preparation of a National Science and Technology Policy statement. The Forum offers all sectors an opportunity to identify and comment on the objectives, goals and optimum courses of action to be pursued in shaping Canada's science and technology effort.

MOSST would like to acknowledge and greatly appreciates the contribution of the organizations and individuals who have provided inputs and advice in the development of this document.

INTRODUCTION

Canada is now facing major challenges to its economic and social well-being brought about by significant technological change. The need to bring together a concerted focus for managing these scientific and technological developments is made all the more pressing because of several critical phenomena; both international and domestic:

International

1. The trend in most industrialized countries is to develop concerted plans or strategies for science and technology at the national level. Much of this has focussed on innovation policies directed to the promotion of strategic technologies such as microelectronics, advanced industrial materials and biotechnology.

2. The internationalization of industrial R&D is occurring at a greater pace. This involves cooperative R&D projects not only between firms responding to global pressures by focussing on precompetitive projects, but also bilateral and multilateral ventures between nations in pooling resources together on major projects. The Eureka and Esprit initiatives among several European nations are such examples.

3. We see an increased concentration by newly-industrialized countries (NICs) on technology. NICs are not only threatening the market share of our traditional resource-based industries, but the NIC share of imports of high technology products has significantly increased. Among OECD countries as a whole, the NIC share of imports of high technology products has increased from less than 1% in 1964 to 12.1% in 1984. These NICs (e.g. Brazil, Mexico, Korea, Hong Kong, Singapore) are clearly shifting their emphasis from low to high technology manufactured exports, and this will have significant bearing on Canada's ability to meet the global, competitive challenge. At the same time, Canada's

high tech trade exports to NICs have to deal with various forms of non-tariff barriers.

4. A global phenomenon of increasing importance and concern is the growing division of the world, not just into trading blocs, but into technology blocs which actively restrict technology flows to countries they see as competitors. The problem of access to technology is emerging as an issue in our relations particularly with the U.S., but also with Europe, and to some extent, Japan. As a medium economy, not part of a major bloc, Canada will have to deal with the trend towards technology protectionism.

Domestic

These global trends place Canada at a major disadvantage on the domestic front. (See Appendix A for table of selected statistics of Canada's scientific and technical activity.) Specifically,

1. Canada as yet has no concerted, focussed strategy to mobilize its scientific and technological resources. What coordination exists between the federal and provincial governments in structuring programs and policies designed to encourage innovation must be strengthened.

2. The industrial R&D infrastructure in Canada is weak and lacks depth. Canada has few major R&D industrial performers. The economy's structural characteristics with foreign firms operating large subsidiaries has had, historically, a significant influence on the low level of R&D investment by industry. Canada has major weaknesses in the high technology sector where the overall trade deficit in 1984 was $12 billion.

3. Our resources sector, (the major contributor to our comparative advantage) is suffering. In certain areas, depletion of resources - overfishing, soil erosion, excessive felling - has undermined the strength of the resource industries, and there is no strong processing sector to fall back on. Canada's capability to compete on world markets is in jeopardy. Competition from industrialized and newly-industrialized economies is encroaching

on Canada's traditional share of world trade in natural resources, and is weakening its hold on long-standing key markets. In R&D performance, Canada's resource industries generally do not compare well with the international competition. A little understood phenomenon, but one that should be assessed, is the extent to which certain resource-related activities and foreign-aid programs have helped create some of the competition now being faced by Canadian industry in certain foreign markets.

4. Canada's overall S&T infrastructure is fragmented and does not have well-developed networks of communications. Collaboration between and among technology centres, industrial research associations, government research laboratories, university research institutes and provincial research organizations could be strengthened.

The Necessity for Action

Given these domestic and international features affecting the development of science and technology, several issues should be noted. First, it would be misleading to suggest that Canada is at a complete standstill in meeting the challenges of technological change. Both the federal and provincial governments have sought to introduce measures to enhance the country's scientific and technological effort. Many provinces are currently reviewing science and technology strategies designed to promote industrial innovation and economic renewal. In some instances, this has involved the strengthening of the existing technology infrastructure, such as a provincial research organization; in others, it has meant the creation of new innovation centres or incubator facilities. Some provinces have also focussed on promoting technology transfer, particularly in the area of university-industry alliances, while others have been engaged in a dialogue to better manage change brought about by technology.

The federal government has been equally active. Measures to streamline the tax incentives and grant support schemes for industrial R&D have been introduced. The May 1985 federal budget introduced an improved definition of R&D, a refundable tax credit for Canadian R&D firms, and set out several new initiatives

to increase the availability of capital for entrepreneurial and innovative ventures. Reviews are underway of the technology centres financed by the federal government, and of our foreign technology acquisition programs, with a view to strengthening the national system of technology diffusion. The government has also announced a long-term Canadian space program, which includes measures to encourage our participation in the Space Station. New, five-year financing for the granting councils has also been provided.

Despite this activity, however, the two levels of government need to improve their co-ordination in science and technology.

Second, the fact that most industrialized nations have recognized that a concerted approach to investment in innovation - in partnership with the public, private and academic sectors - is necessary for economic survival, let alone industrial competitiveness, is all the more reason for Canada to map out its strategy on the scientific and technological front.

Finally, the difference between a nation that is scientifically and technologically avant garde and one that is laggard lies not solely in the measures and resources in place to promote science and technology, but is also defined through cultural attitudes to innovation. Science and technology need to be moved from the periphery to the centre of government thinking and government policy. It is not enough that the value of R&D, for example, be demonstrated through its significant social and private rates of return. This has clearly been demonstrated. It is important to have society recognize the contributions of its scientists, engineers and entrepreneurs through various reward systems such as prizes and awards of distinction and merit. The attitude of senior decision-makers, both in the private and public sectors with respect to the important role of science and technology in society has to be nurtured. This can be done through various means. These range from strengthening public awareness and science education throughout our school system to promoting creative management techniques in the adoption of technology.

For these very important reasons, it is critical that a National Science and Technology Policy urgently be formulated. Such a National Policy will provide for the following objectives:

- To establish Canada's position in the international milieu of economic competitiveness and productivity.
- To provide leadership and a firm sense of direction in science and technology.
- To identify gaps and opportunities in Canada's science and technology infrastructure.
- To build upon provincial and territorial economic priorities and opportunities.
- To provide a framework for the integration of science and technology into the development of policies and strategies in other, related domains.

In order to fully meet these objectives, an agenda to guide discussion on a National Science and Technology Policy must be developed. The agenda is part of a process that must include an action plan to implement the key decisions arising from critical questions. The central questions that must be asked and assessed are:

- How can Canada better develop and acquire new knowledge?
- How can Canadians put this knowledge to work and realize opportunities?
- How can Canadians better cope with and adapt to change brought about by science and technology?
- How can a National Science and Technology Policy be best put to work?

We shall explore each of these issues in the following section.

THE AGENDA FOR A NATIONAL SCIENCE AND TECHNOLOGY POLICY

1. Developing and Acquiring New Knowledge

The acquisition and development of new knowledge is primarily a function of the basic research capacities in our universities and federal government laboratories. The heterogeneity of our university system makes it difficult to generalize; nevertheless, certain features should be noted. While there are over 70 degree-granting institutions in Canada, not all of them have a significant research function. In fact, of the top 30 universities that conduct research, fourteen Canadian universities are responsible for 75% of sponsored research in post-secondary institutions. These are the so-called "research intensive" universities which receive funds from granting councils, provincial governments and the private sector.

Highly-Qualified Personnel and Basic Research

The stock of R&D personnel in our higher education sector has remained remarkably stable from a complement of 13,150 person-years in 1976 to 13,630 in 1983. There is some question as to whether this cadre of researchers is sufficient to meet the increasing levels of demand for the training and re-training of highly-qualified personnel.

If Canada is to cope adequately with the advent of new and strategic technologies, it must have adequate numbers of trained, skilled personnel. NSERC, for instance, has calculated that with reasonable economic growth until 1990, Canada will need 1600 new researchers at the PhD level to meet R&D levels of 1.5% of GNP. There is barely half that total in our academic institutions right now. Canada must also be concerned with the so-called "seed corn" issue - more specifically, faculty must be available in sufficient numbers to teach the science and engineering students bound for industrial jobs in certain key scientific fields.

The question of providing adequate and stable support for our pool of basic researchers poses several challenges to all.

- There is a longer-term need to improve the science teaching at all levels of our school system, particularly, as the Science Council of Canada has pointed out, in the primary and secondary schools, and to encourage more students, especially women, to study relevant subjects.

- We must enhance the capabilities for R&D in our post-secondary institutions in order to maintain Canada's competitive position among developed nations. The Council of Ministers of Education has recognized this issue and is calling upon the provincial and territorial governments to meet the challenge.

- A related issue is the perceived threat (though still not adequately documented) of a "brain drain" from this country to greener pastures elsewhere. Assuming that the greater part of this mobility is to the U.S., recent figures from the National Science Foundation would appear to indicate that, since 1982, the number of immigrant scientists and engineers that are Canadian by birth or listed Canada as their last permanent residence is actually on the decline. Sheer numbers, however, do not present a good measure of the quality of the individuals that have left Canada, and this must be carefully considered.

Concern has been expressed in the past over the instability of funding for university research which has led to declines in the acquisition and maintenance of scientific equipment; decline of foreign student enrolment due to higher tuition fees; and an aging faculty whose median age is now 44, whereas in 1970 it was 37. The combination of these factors has made it difficult to attract and keep young, world-class researchers in Canada.

Recent analysis by NSERC suggests that the erosion of university financing from 1970 to 1983-84, as indicated by universities' capacity to support teaching and R&D has been significant. According to this analysis, the largest contributing factor to the erosion of universities' ability to perform is the decline in funds available for capital expenditures.

It is not just the higher education sector that has complained about the situation. Numerous organizations, including the Science Council of Canada, the Canadian Chamber of Commerce, the Canadian Manufacturers' Association and high-tech firms such as Northern Telecom and SED Systems, have been vocal about the crisis affecting many of our Canadian universities. As David G. Vice, President of Northern Telecom Ltd., has recently put it:

> "Upgrading our universities' research facilities is a pivotal action. These institutions occupy a critical position with the research triad composed of private laboratories, government facilities and post-secondary institutions. University laboratories can and should be leaders in the area of basic research. Still more significantly, post-secondary institutions remain our prime source of the trained personnel needed by a dynamic society."

As Mr. Vice goes on to note, Canada must be able to cope with a turbulent and increasingly competitive world that competes on brainpower and new knowledge. The importance of basic research, for example, is now taking on new critical dimensions in the U.S., the U.K. and Japan.

In Canada, this has not gone unnoticed. In the federal government's most recent budget, it was announced that the budgets of the three granting councils would be increased by an anticipated $1 billion over the next five years, contigent, in part, on investment from the private sector. This initiative is a significant one in several respects. It provides the granting councils with a stable base of funding for the next five years, and therefore will allow the research community to obtain reliable long-term funding. Second, the commitment of such a substantial amount of money given the current fiscal situation signals the federal government's recognition of the importance of maintaining Canada's vital research infrastructure. Third, the funding formula will allow for greater university - industry alliances, and thus promote the transfer of knowledge.

It should also be noted that some provincial governments are also active in strengthening their research systems. Québec, for example, is committing approximately $75 million over the next five years to develop forty research teams of critical size in the province's universities. Quebec's two other major

sources of funds for university research - the granting councils for scientific and medical research - totalled $51.5M in 1985-86. Alberta's $300 million Heritage Foundation for Medical Research is another unique example of significant investment in developing world-class medical research. The Foundation has succeeded in attracting over 85 Heritage Medical Scientists to the Universities of Calgary and Alberta and these scientists have over 300 graduate and post-doctoral students working under them. The Foundation also hopes to develop an Alberta-based medical industry.

Corporate-Higher Education Alliances

Accessing the new knowledge demands not only the use of the resources of our Canadian universities, but also the capabilities of partnerships between different sectors. Corporate-higher education linkages are one of the best expressions of this new co-operative form. The recent announcement by the federal government to match private sector contributions to the granting councils for university research is the latest in a series of initiatives to promote greater university-industry linkages.

The Corporate-Higher Education Forum, an organization whose members include the Chief Executive Officers of Canada's major corporations and the Presidents of most research-intensive universities, estimates that about $52M was spent on corporate support of university R&D in Canada in 1984. This is 2% of total corporate spending on R&D, and represents just under 1% of total current university expenditures.

Despite this small sum, the number of institutional co-operative arrangements that exist is impressive. The innovative models of the Centre for Cold Ocean Resources Engineering in St. John's, the Veterinary Infectious Disease Organization in Saskatoon, and the Centre for Frontier Engineering Research in Edmonton are excellent experiments using private foundation funds and government and industry support to work with academic researchers on applied research projects. Another specific example is that of the Institut national de la recherche scientifique - Télécommunications which works jointly with the Bell Northern Research labs in Montréal, and offers degree programs aimed at university graduates. Industrial research chairs at universities, co-op programs, industrial research institutes, innovation centres,

advanced technology centres, offices of technology transfer and the like, provide other examples. The efforts in this area, however, pose serious questions about the proper role of universities and that of the private sector. Questions surrounding conflict of interest, intellectual property, research evaluation, and strategic roles, among others, are being seriously debated. Several Canadian universities, for example, have been quite active in developing strategies and guidelines for dealing with the private sector.

Federal Laboratories

More will have to be done in exploiting the development and acquisition of new knowledge from our government research laboratories and provincial research organizations. There are over 200 federal government laboratories spread all across the country, with a total annual budget of approximately $1.6 billion. These laboratories employ about 8,100 scientists assisted by over 17,000 support staff. The leadership role in technology development demonstrated by some of these organizations, such as the National Research Council, the Department of Communications and the CANMET laboratories of the Department of Energy, Mines and Resources, has been significant.

The Science Council of Canada has pointed out that federal laboratories were established at different times to serve different purposes, and over time, their activities have, in some instances, become diffuse, vague, and may appear to be inconsistent with contemporary needs. The Wright Task Force Report has suggested that the laboratories be reviewed and required to demonstrate their relevance and usefulness. The Nielsen Task Force on Program Review has undertaken some of this work, and has recommended areas where the enhanced delivery of new knowledge can be effected. The federal laboratories are responding to this challenge, and are currently assessing ways in which they can become more effective and more responsive to client needs.

The National Research Council, for example, has recently announced in its latest five-year plan that encouraging and assisting Canadian industries to implement technological solutions will be its major role. In realigning its research program, the Department of Communications is putting major emphasis

on areas where government requirements - for internal efficiency or better service to the public - provide opportunities to work in partnership with universities and the private sector, with the aim of developing new technologies in harmony with novel approaches to organization and human resource development.

Technology Centres

The network of technology centres that service the needs of industry across Canada are also under scrutiny. The biggest problem facing the more recently-created technology centres appears to be one of sub-critical size and fragmentation. The private sector has been especially critical of this latter aspect, arguing that governments should be concentrating their resources on excellence, rather than continuing to fund centres of sub-critical size and on inadequate economic and technical grounds. The federal government, through MOSST, is currently exploring methods by which these technology centres can be more effectively rationalized, and ways in which they can better achieve their objectives of technology diffusion.

Several provincial governments have instituted a number of technology-specific centres whose purpuse is to assist in the diffusion of technical information to clients. Ontario and Québec have especially been active in this area. In addition, the eight provincial research organizations (PROs), with budgets totalling $125 million and employing over 1,800 people, must be more effectively drawn upon for their expertise in assisting small and medium-sized businesses. The PROs are a significant resource for regional development as well, and are an excellent example of federal-provincial and inter-provincial collaboration in delivering generic technical assistance to numerous clients across Canada. Their ability to draw on foreign expertise as well should not be overlooked. For instance, the eight PROs have just completed a major mission to West Germany in which they met with over thirty research institutions. As a result, several of the PROs have concluded informal arrangements for exchange of technical information and projects to assist Canadian firms.

Canada's Position in World Science

Canada contributes about 4% of the world's scientific literature and develops about 2% of the world's technology. Canada relies extensively therefore

on its international network for knowledge. In the scientific field, there is some concern that Canada's strength in certain scientific fields is declining. Our share of scientific publications worldwide (albeit a partial and still controversial indicator of Canada's scientific health) has declined from 1973 to 1982. Some to reverse themselves. For example, of the top 100 most-cited 1982 articles in the field of chemistry from 1982 to 1984, Canadian research institutions produced 10 of these papers; six alone from the Guelph-Waterloo Centre for Graduate Work in Chemistry. This is encouraging, but other research areas are in jeopardy. For example, the Conseil de la science et de la technologie du Québec is currently assessing the health of plant biology in that province as a result of concerns that the field's decline might seriously affect the prospects for biotechnological developments.

Foreign Technology

A significant portion of the world's technology base is produced abroad. In order for Canada to prosper or even survive in this technological era, the paramount concern of our international technology relations must be to encourage and facilitate the acquisition of foreign technology by the productive parts of the Canadian economy, notably the private sector. A variety of mechanisms can be used to this end, including technology missions, exchange agreements, technology officers in Canadian posts abroad, and programs such as the new Technology Inflow Program (TIP), but these mechanisms should be strengthened. Above all, Canadian firms and technology organizations need good information on and access to new technology. In the area of artificial intelligence, for example, the Canadian Society for Fifth Generation Research has been successful in negotiating a memorandum of understanding with Japan that will allow for the exchange of research personnel and information.

Patents are another source for accessing foreign technology. Patent information, however, is vastly underutilized by Canadian firms and research institutions, thereby diminishing the efficiency of foreign technology exploitation. A study by the U.S. Patent Office showed that as much as 70 percent of the material covered by U.S. patents had not been described elsewhere in the five years after the patents were granted. For a country like Canada, where the vast majority (94%) of its national patents are granted to

foreign applicants, the efficient diffusion of the technological information contained in Canadian patents would go a significant way to improving the productivity and competitiveness of Canadian firms.

In recent years, the Canadian Patent Office has undertaken to promote the diffusion of domestic and foreign technology by providing a technology search service to small manufacturing firms through a nation-wide network of intermediaries, including provincial research organizations, innovation centres, and various federal and provincial agencies.

Closely-related and equally important to the matter of foreign technology is the need to address the growing problem of restricted access to foreign technology or technology protectionism. This issue is a global phenomenon, but one which will strike home particularly in the current context of the bilateral trade negotiations with the United States. The Science Council of Canada has just released a statement that highlights the need for putting technology up-front in these trade negotiations. The Council suggests several ways by which this can be done and it recommends that the negotiations give adequate consideration to the impact of liberalized trade on Canadian R&D, and to key measures to promote technological capability.

The matter of freer trade is obviously quite a sensitive one with governments. Already, for example, Canadian procurement policies in certain fields have been challenged in the course of the American government's preparatory discussions for the next round of multilateral GATT negotiations. Thus, a great deal of complexity and importance surrounds the issue of placing technology up-front in trade negotiations. Several industry associations, including the Canadian Advanced Technology Association, have been quite active in highlighting their positions on this issue.

From a wider perspective, some fundamental questions need to be raised in considering the absorption and accession of foreign technology. These relate to the proper balance between adequate support for domestic R&D capability and support for our ability to absorb foreign technology. This is a very complex issue and requires a sound assessment of a nation's overall science and technology infrastructure. One OECD commentator, for example, in reviewing the success of the technology policies of several European countries and the U.S., has suggested that about five per cent of a

nation's technical resources might be spent on developing new technologies, with the remainder spent on diffusing or incorporating these technologies into standard business practices.

Strategic Technologies

Canada will also have to be selective in its development and application of emerging sciences and technology of strategic importance to the country. While Canada has some research capability in the "core" technologies now developing, such as microelectronics, biotechnology and advanced industrial materials, many are concerned that the base is too small, and the need for a national effort in the area is required, perhaps with the increased development of national facilities.

In some specific technologies, Canada is doing relatively well. According to a national consultation on emerging technologies undertaken by the Science Council of Canada, Canada is among the world leaders in telecommunications, enhanced oil recovery techniques, synthetic fuels, remote sensing, computer software, and hydrogen technologies. Significant capabilities also exist in the areas of advanced alloys, composite materials, conducting materials, biomass technologies, mineral leaching, coal technologies, ice engineering, and construction technologies. Nevertheless, in the major enabling technologies, Canada's effort at development work is insufficient and there is a balkanization of the national effort.

These and other areas must be more effectively explored if Canada is to develop and acquire new knowledge critical to the economic survival of this country. We have to understand not simply the structural and institutional features of science and technology but cultural parameters, such as the effects of biculturalism in research, the special context of the North, and the role of public awareness, as well. The Québec Conseil de la science et de la technologie, in its current 1985 annual review, has been especially eloquent on the first of these questions, and has gone to considerable lengths to discuss the distinctions between the anglophone and francophone university research systems in that province. New Brunswick and Ontario also have an interest in this issue. In New Brunswick, for example, the development and delivery of technical assistance programs in both official languages through the university system there poses significant challenges to the institutions involved. As one expert commentator has remarked, the distinctive national style of Canada's science and technology institutions makes our situation sui generis.

Summary of Issues

The issues raised in this section highlight the various elements necessary for acquiring and developing new knowledge. These include science education in our schools, the stock of highly-qualified personnel and the universities' role in basic research; corporate-higher education alliances; the federal laboratory complex; technology centres; Canada's status in world science; the acquisition of foreign technology and the development of strategic technologies domestically. Several key questions are raised in light of the current context. Among these are:

- **What measures need to be taken to strengthen the scientific and technological research base in Canada's higher education sector?**

- **How can the private sector be encouraged to have a greater involvement in publicly-funded research institutions?**

- **How should we be strengthening the mechanisms available to facilitate the acquisition of foreign technology by the productive parts of the Canadian economy?**

- **What can be done to ensure that corporate - higher education partnerships are strengthened?**

2. Putting Knowledge to Work and Realizing Opportunities

Technological innovation has played an increasingly important role in fueling economic growth in Canada, as well as its major competitors. Putting our knowledge to work and realizing opportunities is heavily dependent on the dynamism and entrepreneurial activity created by a nation's economic engine - the private sector. The climate for innovation in any nation is affected by several variables. These include the structural features of the economy; the cultural attitudes to science and technology; the science and technology base available; the general incentives to innovation; and the capability of the individual firm. Unfortunately, Canada possesses major deficiencies in each of these factors. Table I presents our scorecard with respect to a selection of such measures based on OECD comparisons.

TABLE I

Measure	Canadian Rank Within OECD
GERD/GDP	10
R&D/Sales	
- Chemicals	8
- Electric Machinery	6
- Aerospace	5
- Electronic Components	4
- Drugs and Medicine	7
- Instruments	9
Number of R&D Scientists and Engineers	7
Creativity	8
Productivity	7
Market Share of OECD Exports of High Intensity Products	8
Business Expenditures for R&D/GDP	10

Source: OECD (based on latest data)

Structural Characteristics of the Economy

Structural features of the Canadian economy are often blamed for the poor investments by firms in R&D and science and technology. Canada ranked 10th in GERD performed and funded by business enterprises as a percentage of GDP in 1982 (See Table II). Canada's economy is characterized by a significant degree of foreign ownership and control that has led to a branch-plant economy heavily reliant on R&D performed elsewhere. The country's manufacturing base is found in the Central Canada heartland, and industrial development policies, as a consequence, have had to contend with diversification and regional equity. This, combined with a corporate culture that is largely risk averse, has made the issue of underinvestment in R&D and innovation a fundamental matter that must be solved if Canada is to make its mark on the world economy.

TABLE II

	GERD/ GDP (1984)	GERD/ GDP (1982)	GERD Funded by Business Enterprises as % of GDP (1982)	GERD Performed in B.E. Sector as % of GDP (1982)
Canada	1.35	1.36	0.52	0.65
U.S.	2.70	2.66	1.33	1.94
U.K.	2.27[1]	2.42[2]	1.00[2]	1.50[2]
Germany	2.58[1]	2.58	1.47	1.80
France	2.22	2.10	1.47	1.21
Sweden	2.47[1]	2.22[2]	1.27[2]	1.48[2]
Switzerland	2.28[1]	2.29[2]	1.56[2]	1.70[2]
Japan	2.61[1]	2.47	1.57	1.53
Austria	1.25	1.22	0.59[2]	0.65[2]
Netherlands	2.00	1.98	0.89	1.02
Norway	1.41[1]	1.29[2]	0.52[2]	0.67[2]

1 1983 figures
2 1981 figures

Source: OECD

Management Attitudes to Innovation

Within the corporate world, there is evidence that senior level management perspectives on the value of research and innovation leave much to be desired. A recent study by Arthur D. Little, Inc. on the innovation management practices among firms suggests that North American firms lag behind both Japanese and European companies in regard to corporate expectations for the contribution of innovation. One of the reasons cited for this is that North American firms tend to believe that innovation is the province of scientists and specialists - not operating management. Many Canadian firms, in particular, often display this characteristic. A January 1986 report on technology transfer, released by the Ontario Ministry of Industry, Trade and Technology, suggests that if technological upgrading in Ontario's manufacturing industries is not meeting expectations, it is attributable, in part, to management's resistance to change. This attitude is reflected

in the general lack of interest by firms, especially small businesses, in coping with technological change by training their employees for specific job-related skills. A 1984 survey by the Ontario Manpower Commission noted this deficiency. According to the survey, only 2.7 percent of all employees received formal qualifying or upgrading training that lasted two weeks or more. Some 80 percent of all establishments did not sponsor qualifying or upgrading programs.

Measures of Private Sector Performance in Science and Technology

Other indicators tell a disturbing story. Canada's expenditures on industrial R&D ranked seventh in 1981 among OECD nations. We were eighth in terms of market share of OECD exports of R&D intensive products, and that market share is slipping. Our trade deficit in high-technology (an area that contributes to significant value-added) is the worst among the Economic Summmit countries. In 1984, according to a MOSST analysis, this deficit amounted to $12 billion, and it continues to grow. According to the European Management Forum's 1985 Report on International Competitiveness, Canada ranked 15th out of 22 countries in "innovative forward orientation" - a measure of a nation's acceptance of technology. The same rating is given to Canada for "outward orientation" - a measure of a nation's international market presence.

Most of our resource-based industries - the economic backbone of our country - have seen their market shares slip due to increasingly heavy competition from newly-industrialized countries. Foreign government subsidies, falling demand, and substitution are other factors that have also had an impact. Canada has been slow to adopt new technologies that will enhance our trade in agriculture, wood, fish and minerals, though this latter sector has developed some interesting new initiatives in the area of remote sensing, ceramics and advanced materials.

A creativity index compiled by the European Management Forum based on the average annual number of patents granted to residents per 100,000 inhabitants from 1980 to 1982 shows that Canada ranked 8th among industrialized nations. In the area of biotechnology, for example, our patent activity is anemic. Canada ranked 11th after such countries as Italy, Denmark, Sweden and the Netherlands in the number of U.S. patents issued in selected patent classes affecting biotech-

nology from 1973 to 1983. Canada's share of patented product inventions is low in other high technology product areas such as pharmaceuticals, medicine and office, store, and business machines.

Availability of qualified personnel is, in some instances, a problem. In the Conference Board of Canada's second annual survey on R&D in the corporate sector, over one-third of survey respondents noted that they currently experience shortages of qualified R&D personnel. Shortages are more acute for those companies within the high-technology group, in which 57% currently experience a lack of skilled personnel. These shortages are expected to worsen over the next five years.

The venture capital picture in Canada has not been very promising, though it is hoped that the recent capital gains tax exemption introduced by the federal government will encourage Canadians to invest in new and growing innovative enterprises. The total of all venture capital investment in Canada in 1983 was estimated at slightly more than $100 million. Less than $10 million of this amount went into start-ups. Nearly 40% of all Canadian venture capital investments are currently in the United States. Pre-venture capital and seed financing in this country is virtually non-existent.

Despite increasing its share both as a funder and as a performer over the past decade, private sector investment in science and technology needs considerable strengthening. It needs to be encouraged because study after study has proven that significant spillover benefits accrue to firms, and to the nation as a whole, by investing in R&D. Estimates for the social rates of return on R&D have ranged from 50% to 100%, with private rates of return estimated at about 15-30%. Many analysts have concluded that technological change, more specifically through investment in R&D, has a very significant effect on the rate of national productivity. Indeed, it has been demonstrated that R&D conducted by firms in one sector of the Canadian economy has significant benefits for other sectors.

Recent Initiatives to Meet the Challenge

Suggestions in the past to correct the malaise in private sector R&D have had some impact. Numerous tax incentive schemes that encourage investment in R&D have been put in place, and new experiments are underway. World product mandates as a partial solution to stimulating foreign-controlled firms' performance of R&D

in Canada have had some measure of success. Targets have been formulated to encourage the private sector percentage of GERD, again with some signs of improvement. Our system for protecting intellectual property has been criticized frequently, and is under review to reflect the dynamic nature of new technologies. Nevertheless, more needs to be done by industry, and, in some cases, jointly with governments, to stimulate private sector investment in science and technology.

For this to occur, the private sector must respond to the challenge. There are signs that this is happening. Business has, in partnership with labour, established the Canadian Labour Market and Productivity Centre to help improve productivity, industrial competitiveness and employment prospects.

Several chemical and petroleum processing firms in Ontario have recently founded the Institute of Chemical Science and Technology with a view to improving the competitiveness of the industry. The forestry industry, in conjunction with governments, has been active in developing research strengths through the establishment of a $6 million pulp and paper centre at the University of British Columbia and a $15 million research facility of the Pulp and Paper Research Institute of Canada at the same university campus.

Several firms have made a mark in the high technology domains, notably in the space and aeronautics field; and considerable leadership has been demonstrated by other firms in several other spheres; including the biotechnology, microelectronics and energy-related sectors. The 1986 outlook for corporate R&D spending as a whole is optimistic with an anticipated increase of 11% over 1985. These are positive signals.

Despite a current preoccupation with small businesses, the significant contribution of multinationals to Canada's science and technology effort should not be overlooked. According to a recent Ontario government survey, multinational firms are better than average developers and modifiers of technology, and have strong corporate innovation models and formalized innovation mechanisms.

The encouragement of foreign investment is a priority of both orders of government so as to ensure the removal of impediments for growth, and to create opportunities for the private sector to contribute to maximum economic growth in all parts of Canada.

The procurement mechanism for stimulating technological development is underutilized. The three levels of government annually spend $60 billion in the purchase of goods and services. Procurement policy, including improvements to the contracting-out policy, has significant potential for stimulating the rate of industrial innovation. The study team report on government procurement to the Task Force on Program Review suggests a greater increase of the science and technology activity contracted out by the federal government. As previously noted, however, the matter of procurement is a sensitive issue, and one that must be carefully handled in the current context of technology protectionism and enhanced trade negotiations.

Small businesses, because of their quickness in seizing and developing new markets and their ability to adapt to innovation and changing technologies, offer another strategic element in putting knowledge to work. The development of entrepreneurially-based incubators and metropolitan-based technology councils is a growing phenomenon in this country. Discovery Parks in British Columbia, the Saskatoon Innovation Place, and Sheridan Park in Ontario are examples of the former, while the Calgary Research and Development Authority and the Groupe d'Action pour l'avancement techologique et industriel de la région de Québec (GATIQ) are examples of the latter. The Innovation and Entrepreneurial Management (TIEM) Corporation is an illustration of an entreprise centre concept that involves providing a range of services to small business. Services include technological assessment, improved access to seed capital and facilities to house new businesses. Such centres are now operating in Sydney, St. John's, Québec City, Winnipeg and Vancouver.

Our services sector, particularly that of the consulting engineering industry, constitutes a significant resource. Canada possesses four of the world's 20 largest consulting engineering firms. They are well placed for transfering and diffusing knowledge.

The Economic and Regional Development Agreements with their attendant subsidiary agreements negotiated between the two orders of government represent significant vehicles for stimulating economic growth in partnership with the private sector. Financial commitments under these arrangements total close to $4 billion, over $0.5 billion of which is devoted to encouraging research and development, technology transfer and industrial innovation.

Major challenges remain. For example, how can the science and technology investment base of Canada's corporate sector be broadened? The fact that only 970 out of a total of more than 35,500 manufacturing firms conduct R&D indicates the narrowness of Canada's industrial R&D base. The challenge will be to increase this R&D infrastructure.

How can the partnership between industry and industrial research organizations be expanded? Industry's experimentation with "pre-competitive", generic, applied research organizations is limited; but, there are some effective examples in the pulp and paper, welding, cement, steel, and gas industries. Many of these industrial research organizations have developed strong linkages with universities and government research organizations. With the current reappraisal of government-funded technology centres, the partnership with industry will have to be strengthened.

Canadian industry also has to cope with its own ability to maximize the use of technology - as the Canadian Manufacturers' Association puts it - "as a competitive weapon throughout a broad range of industry." The private sector must commit more investment to technology. As the CMA's recent discussion paper, "Improving Industrial Competitiveness" states:

> "Competitors from industrial countries are improving their own use of technology and competitors from newly-industrialized countries are increasingly using technology in combination with their lower cost base. In short, Canadian companies are in a global technology race."

It may, in fact, be the case, as the Ontario technology transfer study suggests, that many firms do not yet desire new technology. As the authors of the study note, firms may not be convinced that the returns

will be sufficient; they may not feel that they have adequate shop floor skills to make use of the technology, or they may not understand how to manage the change process. In any event, the challenge of increasing the technological sophistication of our business enterprise sector remains, and must be met by industry and governments alike.

Summary of Issues

The focus of this section has been largely on the role of the private sector in putting knowledge to work and exploiting technological opportunities. Past performance has been weak for a number of reasons, but there are now several positive signs that business and industry are responding to the challenge of the global technology race. The case is now being made persuasively in most Western economies that a healthy, domestic, scientific infrastructure is required if a country is to accentuate its technological development. Key questions that must be addressed include:

- **How can Canada target its technology resources in strategic areas so as to maximize the return?**

- **How can the partnership between industry, technological change agents and research organizations be expanded?**

- **What measures are needed to ensure that both traditional sectors and new technology industries deal effectively with the diffusion of new technologies, technology transfer, development, commercialization, financing and market development?**

3. Involving All Canadians and Adapting to Change

With the pace of change in society brought about by technology so rapid, it is essential that a National Science and Technology Policy ensure that Canadians are aware of both the opportunities and problems that might arise. Without a stronger technological capacity in Canada, however, we will be unable to create the wealth and jobs that society expects.

All sectors - government, business, labour and education - have significant rèsponsibilities in preparing society for technological change. Here, the human dimension becomes paramount.

Attitudes to Science and Technology

From a public awareness perspective, it is important to understand how the attentive public views the impact of science and technology on a day-to-day basis. This can be influenced by the media, education, public awareness organizations, the public image of scientists and engineers, and the decisions of elected representatives. The media, of course, have a critical role here. If Canadians are to be sufficiently and properly exposed to the impact of science and technology in their everyday lives, it is, in part, the responsibility of science journalists, writers, editorialists and television commentators. A recent survey conducted for the Association des communicateurs scientifiques du Québec shows some deficiencies in this respect. According to the survey, scientific information and news related to science and technology in the Québec media averaged just over 3% of total coverage in daily newspapers and under 0.5% on television.

Canadians, like most others, have a Janus-like view of the impact of science and technology. On the one hand, they are happy to reap the benefits that science and technology bestow upon them, but are wary of some of the more negative uses made of technology. For example, according to a recent public opinion poll conducted in Québec, the Québécois population feels that scientific and technological developments have had beneficial impacts on material comfort, health and quality of life. By contrast, a majority of the population surveyed feel that scientific developments have had a significantly negative effect on the prospects for world peace.

Technological Change and the Workplace

The Québec attitude survey also serves to highlight another major concern - the employment effects of technological change. The survey concludes that from a long-range perspective, just over 50% believe that technological change will create more jobs than it will eliminate, while 40% state the opposite view. In the medium-term, 26% of those surveyed expressed concern that their jobs could be threatened as a result of technological change.

The debate is far from over. A 1985 study of the Ontario Task Force on Employment and New Technology has found that increasing levels of employment and real

income have been achieved while significant technological change has occured. An ongoing study of the Economic Council of Canada tends to support this line and preliminary findings show that between 1971 and 1981 employment in the high-tech industries grew considerably faster than the average annual growth rate for Canadian industry as a whole. The Economic Council is quick to point out, however, that this trend should be viewed with guarded optimism. Questions of dislocation, new health and safety issues, and distribution of occupations need to be carefully assessed with the technological change. Furthermore, the jury is still out on whether the skill content of technology-affected jobs will be enhanced or eroded. While there is some evidence to suggest that new jobs in the near future will not require significant changes in educational preparation, the rapid pace of technological change will force individuals to learn how to learn. In fact, according to a recent opinion poll of Canadian attitudes to the workplace, the better training of workers was cited as one of the best methods to increase productivity.

In industry, the challenge remains to retain scientists and engineers and to keep them technologically current. The problem of job obsolescence is real, and will become more severe owing to the rapid rate of innovation and general aging of the workforce. In the U.S., for example, Lockheed Corporation has pioneered a unique program, Lending Employees for National Development (LEND), under which scientists and engineers who might otherwise have been laid off are loaned to other companies while retaining their benefits and seniority at the parent company. While Canada has no similar program, the idea of exchange or loan of personnel is an interesting one, and certainly is one mechanism for maximizing the talents of productive individuals.

Preparing management for a more enlightened approach to introducing technology within the business plan is a matter that must be more effectively tackled. Maintaining the vitality of the industry by finding, motivating and retaining productive individuals is a significant management issue. It will require an effective partnership of business, labour and government to deal with these changes. Already, some models exist. The Workplace Innovation Centre established in Manitoba is an example of an innovative initiative devoted to facilitating the adjustment process to technological change. Another case is that of the

Technology Education Project of the Canadian Labour Congress which led to a series of regional workshops and a national conference in February 1986, and identified several issues for collective action. Among these were that the labour movement should reaffirm its commitment to technological change as a priority concern, and that the labour organizations should establish a central bank for technological change information that could be used for various labour movement discussions. Labour Canada has instituted a Technology Impact Research Fund that supports research and demonstration projects on the social and human impact of technological change in the workplace.

A Scientifically-Literate Society

In the long run, other opportunities present themselves in producing a society that is not only comfortable with change, but one which is scientifically-and technologically-literate.

This latter issue has a great deal of currency at the present time in most industrialized nations. In Canada, the Science Council of Canada, in consultation with the Council of Ministers of Education, undertook a major study on the health of science education in our school system. The Science Council's concern was that today's young people are not being adequately prepared to live and work in tomorrow's complex technological society. The Council urged that science education be guaranteed in every elementary school; that girls be encouraged to continue with science and engineering throughout their schooling; that the education show how Canadians have contributed to science and how science has affected Canadian society; and that technology education be introduced in secondary schools. These were some of the major recommendations of the study, and have led, in some instances, to a reappraisal of our science education system. Ultimately, future generations must be better equipped for a technological world.

Several industry and business groups have also expressed their views on this fundamental issue. For example, the Electrical and Electronic Manufacturers Association has released a brief arguing that Canadian society must become more technologically-literate in order that Canada have the trained people to boost Canada's scientific and technological skills.

The Corporate-Higher Education Forum's most recently-sponsored analysis on university graduates and corporate employers also tackles this issue, from the perspective of surveying the reaction of employers to the quality of university education. Generally, the results are positive. However, the report's preliminary findings argue that technical programs should not sacrifice general liberal arts requirements in universities; and that universities, in collaboration with corporations, should expose more technical students to technological innovation and international perspectives.

Summary of Issues

This section has highlighted some of the critical elements of managing change in our society brought about by new technology. Technological change will have some major impacts in the workplace and on employment as a whole. Learning to learn is a major challenge of our day, and all sectors will be responsible for ensuring that Canadians are adequately prepared for technological change. This will require special attention devoted to our public awareness of science and technology programs, as well as strengthening of Canada's science education system. The former puts the focus on the role of science museums, youth science and advancement of science organizations, and popular editions of science magazines and journals. Improving public awareness also means assisting the work force at large and corporate management in coming to grips with the opportunities of technology. Key questions include:

- **What measures need to be taken to enhance the joint collaboration of labour and management in the introduction of new technologies?**

- **How can public awareness vehicles for promoting science and technology be better improved?**

4. Putting a National Science and Technology Policy to Work

The Organization for Economic Co-operation and Development has identified three essential components in pursuing a course of economic renewal through science and technology.

1. Clear focal points must be created for a national technological effort.

2. There must be a solid basis (infrastructure) for accumulating and transmitting knowledge and know-how.

3. There must be an appropriate climate for innovation and entrepreneurship.

As the previous discussion has noted, putting a national strategy to work requires a solid infrastructure for developing and acquiring new knowledge; for putting this knowledge to work and exploiting opportunities; and for managing the impact on society of technological change.

Mobilization of a National Effort

Clear and effective leadership for directing the national technological effort will be necessary. A National Science and Technology Policy, which unites the diverse range of federal and provincial programs and policies affecting innovation and research, will provide this focal point. This policy will need to be directed to several key areas.

Among the fundamental new orientations, Canada needs an integrated program and a capability to target its S&T resources in strategic areas so as to maximize the return. In the area of biotechnology, for example, considerable effort has been devoted to preparing a National Biotechnology Strategy that has brought together Canada's major performers in this strategic technology area through various networks. In order to compete with other nations that have concerted efforts in strategic technologies, Canada must provide an overall framework for the development of other strategic technologies of importance to the country, such as information technologies, advanced materials,opto-electronics, artificial intelligence, remote sensing and new construction technologies.

With a proper assessment and market niche identification, these new technologies can lead to the establishment, as is already underway, of new firms and new industries. This strengthening will also play a vital role in supporting existing resource and manufacturing industries.

Governments, universities and the private sector will have to establish partnerships and define their respective roles in developing our strategic technologies.

Using our Infrastructure

We must also learn to use more effectively what we have in place. Canada's scientific and technological infrastructure represents a significant asset in brainpower. We must strive to mobilize it for national purposes. Fortunately, we have some excellent examples of this concentration already in place. The National Research Council's Industrial Research Assistance Program comprises a vast network of technical resources that, in conjunction with provincial research organizations, university-based technology centres and consulting engineering organizations, provides a much needed technical delivery system to Canada's industrial firms.

Our universities are striving to develop critical mass in certain areas through various joint initiatives and consortia. A well-known model of this is the Canadian Microelectronics Corporation, set up by NSERC to enable Canadian universities to carry out effective research and scholarship in all aspects of integrated circuit design. Other examples include the various co-operative industrial research organizations such as the Pulp and Paper Research Institute of Canada, the Welding Institute of Canada, and the Canadian Steel Industry Research Association. Networking among institutions is a specific objective of the Canadian Institute for Advanced Research. The Institute brings together the talents of Canada's researchers to explore specific projects in fields such as robotics and space research.

These, and other initiatives, are encouraging models of cooperation within our industry and between industry, government and universities that should be encouraged and built upon.

Providing the Necessary Climate

The third major feature necessary for a national thrust in science and technology is the establishment of an appropriate climate for innovation and entrepreneurship. This involves a clear framework for competition and cooperation in industry, judicious regulatory reforms, provision of incentives and support for innovators, and the elimination of institutional, bureaucratic, financial and other impediments that can arrest the development of a healthy entrepreneurial activity within the country.

Key decisions are being made in the areas of trade strategy, tax policy, procurement policies, venture capital assistance and R&D grants. These must be continually monitored and evaluated.

An appropriate mix is necessary to stimulate economic renewal. For instance, the federal government is strengthening the tax incentive and grant support programs for R&D in industry. A combination of tax-based and non-tax support has been tailored to meet the varying needs of small, medium and large-scale industries. The government is aiming for a rationalized, simplified, government-wide system of R&D support. The government is also looking for ways in which current industrial R&D performed by the public sector can be streamlined and made more accessible as well as efficient. Consultation is underway to develop much of this in harmony with the programs and measures of provincial governments so that better co-ordination can result. In addition, MOSST is actively involved in looking at mechanisms that can improve the technology diffusion in this country, and has recently completed an analysis of the situation.

The window available to Canada in establishing a National Science and Technology Policy will not be open for very long. International science and technology activities, in particular, are gradually closing this opportunity. We must act now in marshalling our resources and brainpower in order that Canada may assure its economic renewal. We must collectively develop a vision of Canada's economic place in the world economy, and identify the necessary targets that will mobilize our strategic offensive.

<u>Summary of Issues</u>

This concluding section has reviewed some of Canada's assets in science and technology and suggests an agenda for pooling these strengths under a National Science and Technology Policy framework. Questions that must be addressed include:

- **How can we ensure that the various regions of Canada share the benefits of technology?**

- **What should be the respective roles and responsibilities of governments, the private sector, universities and labour in implementing a National Science and Technology Policy?**

- What value would specific objectives and long-range targets have in guiding the implementation of a National Science and Technology Policy?

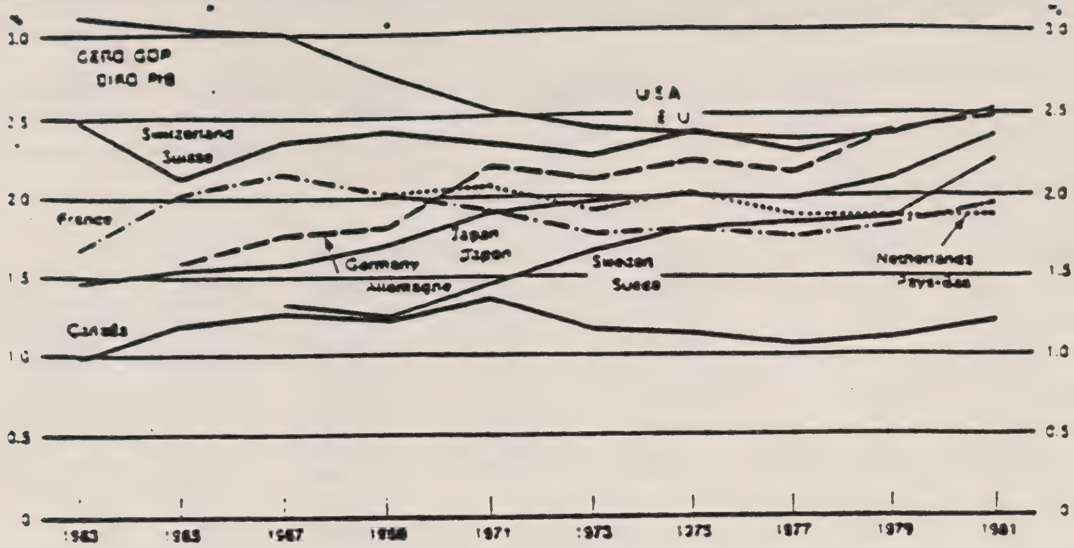
- What are the mechanisms required to ensure continued coordination and collaboration among all parties involved?

APPENDIX A

Selected Statistics of Canada's Science and Technology Activity

Proportion of the Economy Devoted to R&D for Selected OECD Countries, 1963-1981

Proportion de la richesse nationale consacrée à la R-D dans certains pays de l'OCDE, 1963-1981



Gross Expenditure on R&D as a Percentage of GDP

	Government Spending	Industry Spending
Canada	.64	.48
Australia	.78	.22
Austria	.51	.58
Finland	.56	.63
France	1.07	.82
Germany	1.04	1.42
Italy	.48	.51
Japan	.64	1.48
Netherlands	.89	.87
Norway	.73	.51
Sweden	.89	1.28
Switzerland	.55	1.72
United Kingdom	1.21	1.02
United States	1.24	1.23

* Source: OECD Selected S&T Indicators. Data are for 1981 except for Switzerland (1979).

Scientists and Engineers (NSE + SSH) Engaged in R&D, in Selected OECD Countries, per 10,000 Persons in the Labour Force

Country	1971	1973	1975	1977	1979	1981
Scientists and engineers						
United States	527,100	518,400	532,700	570,300	621,000	691,400
Japan	247,309	292,097	316,860	331,467	366,998	392,625
Germany	90,206	101,019	103,736	110,972	121,978	128,162
France	60,100	62,700	65,300	67,981	72,889	85,500
Canada	..	21,734	22,960	24,900	26,300	29,670
Netherlands	14,192	14,247	15,460	17,368	18,270	19,436
Sweden	..	12,362	14,759	-	11,760	15,235
Switzerland	8,541	9,854	10,568	11,835	10,720	-
			thousands			
Total labour force						
United States	87,198	91,756	95,955	101,142	107,050	110,315
Japan	51,860	53,260	53,230	54,520	55,960	57,070
Germany	26,910	26,985	26,397	26,074	26,449	27,376
France	21,638	22,083	22,310	22,697	23,059	23,271
Canada	8,727	8,358	10,059	10,578	11,287	11,978
Netherlands	4,793	4,802	4,862	4,877	4,948	5,593
Sweden	3,961	3,977	4,129	4,174	4,268	4,332
Switzerland	3,167	3,203	3,027	2,935	2,972	3,060
			ratio			
Scientists and engineers per 10,000 persons in the labour force						
United States	60.4	56.5	55.5	56.4	58.0	62.0
Japan	47.7	54.8	59.5	60.8	65.6	69.0
Germany	33.5	37.4	39.2	42.6	46.1	47.0
France	27.8	28.4	29.3	30.0	31.6	37.0
Canada	..	23.2	22.8	23.5	23.3	25.0
Netherlands	29.6	29.7	31.8	35.6	36.9	36.0
Sweden	..	31.1	35.7	-	-	35.0
Switzerland	27.0	30.8	34.9	40.3	36.1	-

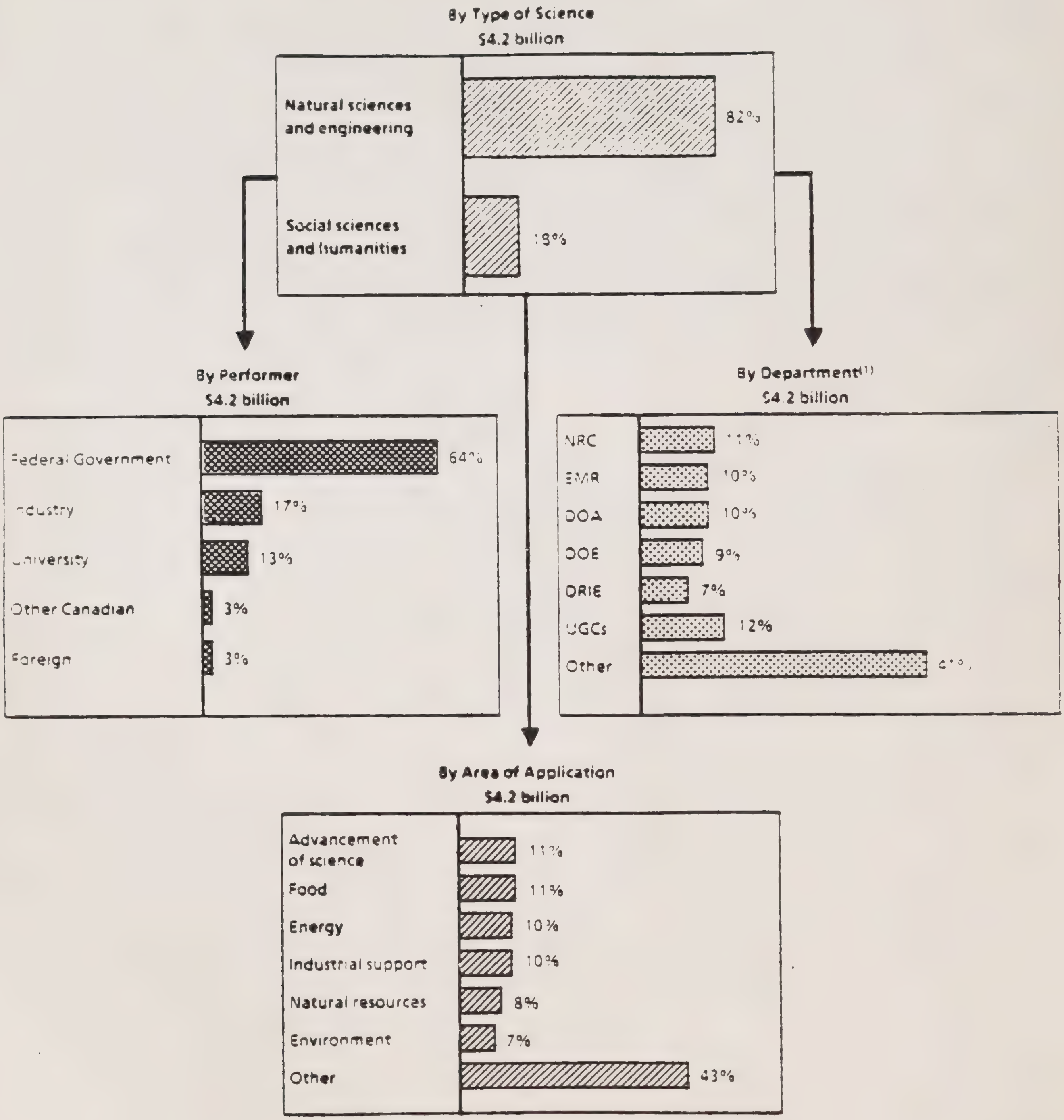
Sources: "Science and Technology Indicators. Basic Statistics Series, Volume C, Total R&D Personnel", OECD DSTI/SPR/82.59, Paris, 1982.
Statistical Yearbook, UNESCO, Paris, 1981 "Labour Force Statistics 1962-1982", OECD, Paris, 1983, p 19.

NATIONAL R&D EXPENDITURES, 1985
(NATURAL SCIENCES, ENGINEERING, SOCIAL SCIENCES & HUMANITIES)
($ MILLIONS)

FUNDERS	PERFORMERS					TOTAL	
	Federal Govt	Provincial Govts	Business Enterprise	Universities	Others*		
Government: Federal	1,480	-	303	460	29	2,272	(35.8%)
Provincial	-	165	39	169	68	441	(6.9%)
Total	1,480	165	342	629	97	2,713	(42.7%)
Business Enterprises	-	-	2,446	34	18	2,498	(39.3%)
Universities	-	-	-	701	-	701	(11.0%)
Private Non-Profit	-	-	-	133	36	169	(2.7%)
Foreign	-	-	256	13	-	269	(4.2%)
Total	1,480 (23.3%)	165 (2.6%)	3,044 (47.9%)	1,509 (23.8%)	152 (2.4%)	6,350	(100.0%)

* Others: Private non-profit organizations ($75M) and Provincial Research Organizations ($77M)

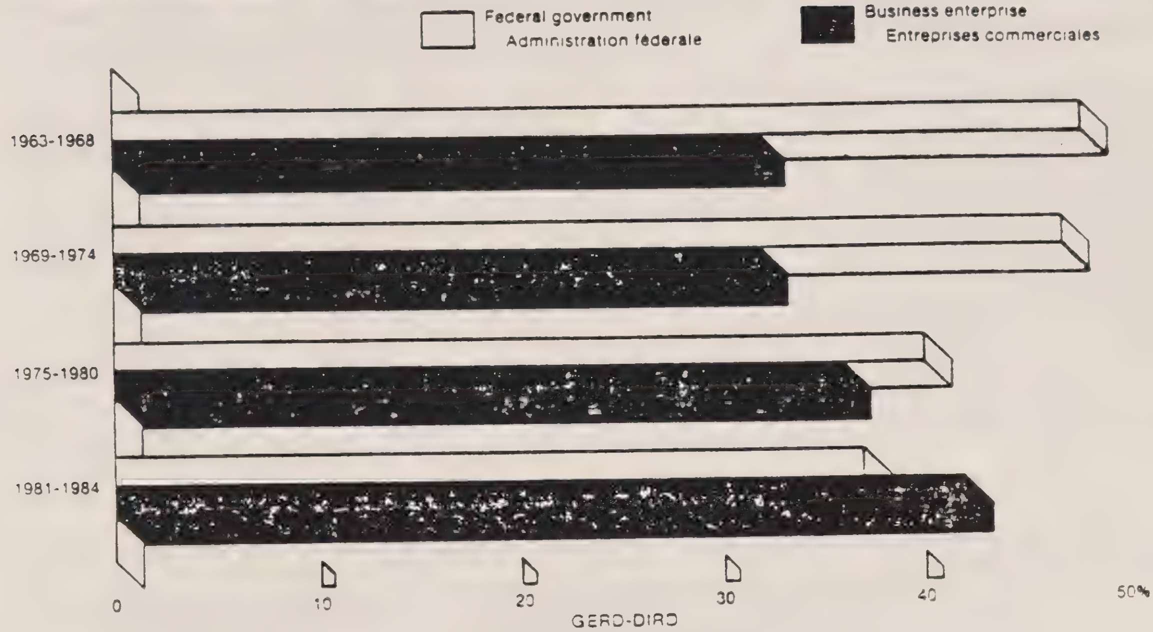
Distribution of Federal Expenditures on Science and Technology, 1985-86



(1) NRC = National Research Council
EMR = Energy, Mines and Resources
DOA = Agriculture
DOE = Environment
DRIE = Regional Industrial Expansion
UGCs = University Granting Councils (total for Medical Research Council, Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council)

Federal and Business Enterprise Funding of R&D, 1963-1984

Financement de la R-D par l'administration fédérale et les entreprises commerciales, 1963-1984



Source: Statistics Canada

Federal Expenditures in Support of Post-Secondary Education:[1] Research[2] ($ millions)

	1982-83	1983-84	1984-85
Research Granting Councils[3]			
Natural Sciences and Engineering Research Council	210.8	238.7	260.6
Medical Research Council	106.5	113.9	127.5
Social Sciences and Humanities Research Council[4]	30.8	35.9	37.9
Subtotal Research Granting Councils	348.1	388.5	426.0
Other Departments/Agencies			
National Research Council	25.2	27.2	31.1
Health and Welfare Canada	8.4	8.9	14.5
Secretary of State of Canada	0.0	0.2	9.1
Agriculture Canada	5.9	6.0	7.8
Energy, Mines and Resources	6.7	9.0	7.5
Environment Canada	4.8	7.3	6.5
Department of National Defence	5.0	5.9	5.4
Other	13.2	11.6	15.2
Subtotal Other Departments/Agencies	69.0	76.0	97.1
Total Research Expenditures	417.2	464.5	523.1

1 Source (except as noted): Statistics Canada, Education, Culture and Tourism Division, Survey of Federal Government Expenditures in Support of Education, 1984-85.

2 Includes all research spending except for: a) amounts directed to individuals for education support which are reported as Student Assistance; and, b) administration expenses, which are reported as Other Expenditures, Direct Federal Support.

3 The total post-secondary education spending of the Research Granting Councils has been divided into three categories: Research Support, Student Assistance, and Administration. Only the amounts for Research Support are reported.

4 Source (for 1983-84): Statistics Canada, Science and Technology Statistics Division, Federal Government Expenditure on Activities in the Social Sciences and Humanities, 1970-71 to 1985-86.

Source: Secretary of State

Federal and Provincial Support to Post-Secondary Education in Canada

A Report to Parliament, 1984-85

Balance of Trade in High-Technology
and Other Manufactured Products: 1980, 1984

(Millions of Dollars)

	1980	1984
High Technology	-8,157	-11,974
Medium Technology	-4,628	-6,114
Low Technology	-2,821	-4,453
Resource-Related	13,243	15,262
Motor Vehicles and Parts	-2,661	2,994
Total	-5,024	-4,335

Source: Statistics Canada, Technology and Trade Statistics: Part I, July, 1985.

Canadian Export Market Shares of High R&D Intensity Products: 1970, 1983

(% of Total OECD Exports)

Aerospace	1970	5.9
	1983	3.5
Computers	1970	5.6
	1983	5.8
Electronic Equipment	1970	1.9
	1983	1.8
Telecommunications Equipment	1970	6.8
	1983	3.1
Drugs	1970	2.1
	1983	1.7
Scientific Instruments	1970	3.1
	1983	2.0
Electronic Machinery	1970	1.7
	1983	1.2
Non-Electrical Machinery	1970	10.6
	1983	10.5
Chemicals	1970	0.8
	1983	2.3

Source: OECD - Trade in High-Technology Products, DSTI/SPR/84.66, January 1985

APPENDIX B

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LES MOYENS

DE

NOTRE AVENIR

Document de travail pour la Conférence sur
la Politique nationale des sciences et de la technologie
qui se déroulera en juin 1986, à Winnipeg

Rédigé par le Ministère d'État
chargé des Sciences et de la Technologie

le 26 mai 1986

VEUILLEZ NOTER

AVERTISSEMENT

Le paragraphe suivant aurait dû apparaître à la fin de la page 10. Nous nous excusons de l'inconvénient.

> "On a exprimé quelque inquiétude dans le passé concernant l'instabilité du financement de la recherche universitaire qui a entraîné un déclin dans l'acquisition et l'entretien du matériel scientifique; un déclin du nombre d'étudiants étrangers à cause des frais de scolarité élevés; et un corps professoral dont l'âge moyen est de 44 ans alors qu'il était de 37 en 1970. Tous ces facteurs ont fait qu'il a été difficile d'attirer et de garder une classe de jeunes chercheurs au Canada".

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PRÉCIS ADMINISTRATIF

Le présent document de travail vise à fournir à la Conférence nationale une vue synoptique des grands axes de l'effort scientifique et technique du Canada. Cette description s'inscrit dans le cadre tracé l'an dernier, lors de la rencontre des ministres fédéral et provinciaux chargés des Sciences et de la Technologie, pour l'élaboration d'une Politique nationale des sciences et de la technologie.

Le texte évalue les principales forces internationales et internes qui gouvernent les progrès faits par notre pays sur le front scientifique et technique. Parmi les facteurs externes, citons l'internationalisation croissante de la R-D et la concertation entre certains pays pour l'évaluation d'une stratégie de développement de technologies nouvelles. Sur le plan interne, le Canada doit relever ce défi, mais son effort est gêné par certaines faiblesses structurelles et organisationnelles. Tels sont l'insuffisance de l'infrastructure de R-D du secteur privé et le morcellement de l'appareil scientifique et technologique du pays.

Ces problèmes mettent en évidence l'urgente nécessité de concerter l'action des Canadiens face à de nouveaux défis, et de préciser les objectifs de la Politique nationale des sciences et de la technologie.

Le document désigne ensuite quatre thèmes qui pourraient alimenter un débat sur les lignes de force d'une Politique nationale des sciences et de la technologie.

<u>L'acquisition et le développement de nouvelles connaissances</u> constitue l'un de ces thèmes, portant largement sur le rôle des universités en matière de recherche fondamentale et de formation des effectifs hautement qualifiés. Malheureusement, de nombreuses observations montrent que le dynamisme de notre système universitaire s'affaiblit, en raison d'un financement toujours insuffisant, de la désuétude croissante de l'équipement des laboratoires universitaires, du vieillissement du personnel de recherche et du départ possible de nombreux jeunes chercheurs vers des horizons plus prometteurs.

Les laboratoires de l'État fédéral, les centres technologiques et les organismes provinciaux de recherches constituent un important appareil d'acquisition et de développement des nouvelles connaissances, mais il est malheureusement compartimenté. Notre pays pourrait cependant s'appuyer sur certains de ses points forts dans les technologies avancées d'importance stratégique, qu'il faudrait développer davantage et incorporer dans de plus solides plans nationaux à long terme.

Ensuite, <u>pour mettre ces connaissances à profit et saisir des possibilités,</u> il faudra que le secteur privé fasse un effort particulier: or, il risque d'être découragé dans cette tâche par certaines de ses caractéristiques structurelles. De plus, il faudra que, de leur côté, les autorités publiques s'efforcent de mettre en oeuvre des incitations à l'investissement dans le développement des sciences et des techniques. Elles devront utiliser judicieusement les achats de biens et services par des organismes publics, encourager l'investissement des capitaux étrangers, favoriser la création des petites entreprises, améliorer la stratégie commerciale et maximiser l'utilisation des ententes de développement économique et régional.

Cette action nécessite <u>la mise sur pied d'un potentiel national d'adaptation efficace au changement</u>. On devra améliorer les programmes de sensibilisation du public, mieux préparer les jeunes Canadiens grâce au renforcement de l'enseignement des sciences et faciliter l'adaptation de la main-d'oeuvre à l'évolution technologique. Comme le document le souligne, il faut que nos cadres de gestion connaissent mieux les techniques nouvelles et les introduisent dans l'appareil de production.

Le présent document met en lumière quelques points forts et possibilités dont jouit le Canada en matière de sciences et de technologie, par rapport à chacun des trois thèmes susmentionnés. Il décrit, notamment, les réalisations dans les secteurs des télécommunications et de l'aérospatiale, ainsi que les récents efforts d'appui du programme spatial canadien. Les initiatives scientifiques et technologiques nouvelles se multiplient, surtout depuis la participation accrue des gouvernements provinciaux à la définition de stratégies de principe en sciences et en technologie, et, le cas échéant, à la mise en oeuvre de nouvelle mesures pour renforcer l'initiative privée et l'innovation dans l'industrie.

<u>La mise en oeuvre d'une politique nationale des sciences et de la technologie</u> exigera les actions suivantes:

- la mise en évidence des axes choisis pour l'effort technologique national, et la concertation de l'action de tous les secteurs productifs de l'économie;

- la création d'un appareil dynamique pour le recueil et la diffusion des connaissances et du savoir-faire nouveaux; et

- la mise en place de conditions favorables à l'innovation et à l'esprit d'entreprise.

PRÉFACE

Le présent document de travail a été rédigé par le Ministère d'État chargé des Sciences et de la Technologie pour servir de référence au débat sur la Politique nationale des sciences et de la technologie, qui se déroulera dans le cadre de la Conférence nationale des 9 et 10 juin 1986 à Winnipeg.

Ce document s'efforce de fournir aux participants une vue synoptique sur certains problèmes cruciaux du développement des sciences et des techniques au Canada, afin que le débat se déroule de façon avertie. Se limitant à cet objectif, il ne propose pas de lignes d'action et ne fait pas de recommandations. Bien que le texte renferme quelques statistiques discutables, les chiffres signalés sont néanmoins considérés, de façon générale, comme représentatifs de la situation des activités scientifiques et techniques au pays. Pareillement, il faut aussi rappeler au lecteur l'évolution longue et assez mouvementée du débat concernant la Politique des sciences et de la technologie au Canada. La direction première de ce débat a été donnée, en partie, par le Comité spécial du Sénat sur la politique scientifique, qui a oeuvré de la fin des années soixante au début des années soixante-dix, et par les travaux du Conseil des sciences du Canada et de l'OCDE. Depuis, de nombreuses organisations, dont le Conseil économique du Canada, l'Institut Fraser, l'ancien Institut canadien de politique économique et, tout récemment, la Commission royale d'enquête sur l'union économique et les perspectives de développement du Canada (ou Commission Macdonald), ont favorisé activement l'étude nationale de cette question vitale sous plusieurs rapports, parfois très différents. Diverses commissions et organisations provinciales ont également prêté un grand appui.

Nous signalons aussi au lecteur que, partout dans le texte, le terme "sciences et technologie" est un raccourci; dans certains cas, les normes institutionnelles qui s'appliquent aux sciences (l'examen par les pairs, par exemple) ne s'appliquent pas à la technologie, et vice versa.

En outre, l'étude de la politique des sciences et de la technologie est intentionnellement vaste et, bien souvent, elle recouvre d'autres politiques telles que la politique industrielle et la politique étrangère.

Il se fonde sur l'engagement pris par les ministres fédéral, provinciaux et territoriaux chargés des Sciences et de la Technologie, lors de leur rencontre de février 1985, au sujet de l'élaboration d'une Politique nationale des sciences et de la technologie. Cette rencontre a permis de mettre en lumière trois priorités stratégiques, et les autorités publiques ont décidé de:

1. Stimuler l'investissement du secteur privé en matière d'innovation.

2. Favoriser le transfert et l'application des technologies.

3. Appuyer d'importants travaux de recherche fondamentale visant, à plus long terme, à doter le pays d'une compétence scientifique lui permettant de se placer à l'avant-garde dans le secteur industriel.

Cette dernière priorité est apparue comme un thème majeur du débat lors de la rencontre ultérieure des ministres à Lac-Meech, en septembre 1985.

En vue de donner le suivi voulu aux initiatives décidées par les ministres à Calgary (fév. 85) et au Lac Meech (sept. 85), il a paru nécessaire de convoquer une Conférence nationale portant sur les priorités stratégiques choisies par les ministres. Le Ministère a donc rédigé le présent document, afin de préciser les grandes initiatives suivantes:

1. Comment acquérir et développer le mieux possible les connaissances nouvelles.

2. Comment mettre ces connaissances à profit et saisir des possibilités qui se présentent.

3. Comment assurer la participation de tous les Canadiens et la promotion de la capacité d'adaptation au changement.

4. Comment concerter la mise en oeuvre d'une Politique nationale des sciences et de la technologie.

Ces quatre thèmes se recouvrent quelque peu. Toutefois, chacun d'eux englobe un certain nombre de questions importantes et, dans leur ensemble, ils alimenteront le débat concernant la Politique nationale des sciences et de la technologie.

À la suite de la Conférence nationale, le Ministre fédéral et ses collègues des provinces et des territoires en étudieront de concert les conclusions, ainsi que celles d'autres mécanismes de consultation, en vue d'élaborer un Énoncé de politique nationale des sciences et de la technologie. Cette Conférence aura offert à tous les secteurs intéressés la possibilité d'étudier les objectifs, les buts particuliers et les lignes de forces à suivre, et aussi de façonner l'action du Canada dans les domaines des sciences et de la technologie.

Le MEST tient à souligner la précieuse contribution des organismes et des personnes qui, par leurs renseignements et leurs conseils, ont aidé à la préparation de ce document. Nous les en remercions vivement.

INTRODUCTION

Le Canada fait actuellement face aux sérieuses conséquences d'un profond changement technologique pour sa santé économique et l'équilibre de la société. Plusieurs facteurs cruciaux rendent encore plus pressante la nécessité de concerter les parties intéressées pour faciliter l'assimilation de ces progrès scientifiques et techniques. Ces facteurs apparaissent sur les plans international et intérieur.

Les facteurs internationaux

1. La plupart des pays industrialisés cherchent à élaborer des plans d'action ou des stratégies de développement des sciences des techniques grâce à une concertation au plan national. C'est surtout la promotion de technologies de pointe, telles que la microélectronique, les matériaux industriels avancés et la biotechnologie, qui a entraîné l'adoption des politiques d'innovation correspondantes.

2. On observe une internationalisation de plus en plus rapide de la R-D industrielle. Non seulement les entreprises se concertent-elles pour réaliser hors concurrence des programmes de R-D répondant à des impératifs globaux, mais encore certains pays s'entendent-ils à deux ou à plusieurs pour réaliser de grands projets techniques. Tels sont, par exemple, les projets Eurêka et Esprit, que plusieurs nations réalisent de concert.

3. On remarque aussi un effort croissant des nouveaux pays industrialisés en matière de technologie. Non seulement cherchent-ils à s'approprier les parts du marché acquises par nos industries traditionnellement transformatrices de matières premières, mais ils ont aussi pénétré notablement dans les marchés de produits à forte composante technologique. Pour l'ensemble des pays de l'OCDE, les importations de produits de pointe provenant des pays nouvellement industrialisés sont passées de 1 pour cent en 1964 à 12,1 pour cent en 1984. Ces pays (le Brésil, le Mexique, La Corée, Hong-Kong et Singapour) consacrent de plus en plus d'effort à l'exportation de produits de pointe, en relâchant celui qu'ils accordent à l'exportation de produits à faible composante technique. Cette évolution aura d'importantes conséquences pour les capacités du Canada à relever le défi de la concurrence mondiale. En même temps, les produits de pointe que le

Canada exporte aux pays nouvellement industrialisés se heurtent à divers obstacles non tarifaires.

4. Il se produit un phénomène universel qui prend de plus en plus d'importance, c'est-à-dire la division croissante du monde non seulement en blocs de commerce, mais aussi en blocs de technologie qui restreignent activement l'exportation de produits techniques aux pays qu'ils considèrent comme des compétiteurs. La question d'accès à la technologie pose un problème dans nos relations, surtout avec les États-Unis, mais aussi avec l'Europe et, dans une certaine mesure, avec le Japon. Parce qu'il a une activité économique moyenne et qu'il ne fait donc pas partie d'un bloc principal, le Canada devra prendre des mesures face à cette tendance au protectionnisme dans le domaine de la technologie.

Les facteurs internes

L'action de ces facteurs externes place le Canada dans une situation très déavantageuse sur le plan interne (Voyez les tableaux des statistiques choisies de l'activité scientifique et technique du Canada, dans l'Annexe A). En particulier:

1. Le Canada ne dispose pas encore d'une stratégie concertée et explicite de mobilisation des ressources scientifiques et technologiques. Il faut renforcer la collaboration entre les administrations fédérale et provinciales en vue d'articuler les programmes et d'élaborer la politique d'encouragement à l'innovation.

2. L'infrastructure de R-D industrielle du Canada est peu dynamique, et elle manque d'assises. Il n'existe que peu de grands réalisateurs de R-D dans le secteur industriel. Les caractéristiques structurelles de l'économie canadienne, qui englobe d'importantes filiales de sociétés étrangères ont eu, dans le passé, une influence défavorable sur l'effort financier de l'industrie en R-D. Le secteur de fabrication de pointe souffre de graves faiblesses, et le déficit de la balance commerciale à ce titre a atteint 12 milliards de dollars en 1984.

3. Le secteur d'exploitation des ressources naturelles souffre également, bien qu'il fasse une contribution de premier plan à la balance commerciale. Dans certains domaines, l'épuisement des ressources (par

surpêche, érosion des sols agricoles, coupes forestières exagérées) a miné le dynamisme des industries concernées, alors qu'il n'existe pas de secteur de fabrication puissant pour prendre la relève. Le pouvoir concurrentiel du Canada sur les marchés mondiaux ne fait que décliner. La concurrence des pays industrialisés et nouvellement industrialisés réduit la part traditionnelle du Canada sur les marchés mondiaux des ressources naturelles, et sa présence faiblit dans des marchés fort importants, acquis de longue date. De plus, l'effort de R-D accompli par les industries de ressources n'est généralement pas à la hauteur de celui consenti par leurs homologues étrangers. La mesure dans laquelle certaines activités liées aux ressources et certains programmes d'aide à l'étranger ont suscité une partie de la concurrence que connaît actuellement l'industrie canadienne sur certains marchés étrangers, est un facteur peu connu qui devrait cependant être évalué.

4. L'infrastructure de l'effort général de S-T du Canada est malheureusement morcelée, et ne dispose pas de réseaux d'intercommunications suffisamment développés. Il faudra renforcer la collaboration entre les centres de technologie, les associations de recherche industrielle, les laboratoires de recherches fédéraux, les instituts de recherches universitaires et les organismes provinciaux de recherches, et au sein de ces divers groupes.

<u>Nécessité de l'action</u>

Il faut prendre conscience de plusieurs faits en relation avec les facteurs internes et internationaux qui gouvernent le développement des sciences et de la technologie. En premier lieu, il serait erroné de croire que le Canada, ne réagit nullement aux défis de l'évolution technologique. Tant au niveau fédéral que provincial, les gouvernements ont pris des mesures en vue d'accroître les efforts scientifiques et technologiques du pays. Bien des administrations provinciales s'efforcent de raffiner une stratégie scientifique et technique en vue de développer l'innovation industrielle et de favoriser un renouvellement de l'économie. Dans certains cas, il leur a fallu renforcer l'infrastructure technologique en place, tel l'organisme provincial de recherches; dans d'autres, elles ont créé un centre d'innovation technique ou des "centres d'incubation". Certaines administrations provinciales ont également favorisé la diffusion de la technologie nouvelle, en particulier

grâce au couplage entre universités et industries, alors que d'autres ont entamé des consultations en vue de gérer plus efficacement le changement introduit par la technologie nouvelle.

L'Administration fédérale a également pris des mesures pour simplifier les programmes d'incitation fiscale et de subventions à la R-D industrielle. Elle a incorporé, dans son budget de mai 1985, une meilleure définition de la R-D, un crédit d'impôt remboursable pour les sociétés canadiennes de R-D, et plusieurs nouveaux moyens d'accroître la disponibilité de capitaux pour des activités d'innovation et d'initiative privée. Elle analyse la performance des centres de technologie que l'État fédéral finance, et les programmes canadiens d'acquisition de technologie étrangère en vue de renforcer le réseau national de diffusion de la technologie nouvelle. Le gouvernement a aussi annoncé la mise en oeuvre d'un programme spatial canadien de longue durée, qui comprend des mesures pour encourager la participation des industries canadiennes au programme de station spatiale. Un nouveau financement des conseils subventionnaires, pour une période de cinq ans, a également été consenti.

Cependant, outre ces activités, il faudrait que les deux paliers d'administration améliorent leur concertation en matière de sciences et de technologie.

Et comme la plupart des pays industrialisés se sont rendu compte qu'il fallait concerter les investissements des secteurs publics, du secteur industriel et des universités en matière d'innovation afin d'assurer la viabilité de leur économie, sans parler du pouvoir concurrentiel de leur industrie, le Canada a encore plus de raisons de préciser sa stratégie d'avancement sur les fronts scientifique et technologique.

Enfin, ce ne sont pas seulement les mesures prises et les ressources mises en oeuvre qui font la différence entre le pays scientifiquement et techniquement à l'avant-garde et celui qui traîne la patte, mais aussi les attitudes sociales en matière d'innovation. Il faut que les questions de sciences et de technologie ne reste pas une préoccupation d'arrière-plan pour les décideurs de l'État, mais qu'elles deviennent pour eux un pôle de réflexion. Il ne suffit pas que les retombées de la R-D apparaissent clairement sur les plans social et privé, ce qui a été amplement prouvé. Il est important que la société souligne les réalisations de ses scientifiques, ingénieurs et entrepreneurs par divers programmes de récompense qui décernent, par exemple, des

prix et des primes de distinction et de mérite. Il faut aussi que les décideurs, tant des secteurs publics que le l'industrie, soient convaincus de l'importance sociale du rôle des sciences et de la technologie. Divers moyens permettent d'y parvenir: sensibilisation du public à cette importance, meilleure formation des jeunes aux sciences dans l'appareil scolaire et promotion de technique de gestion inédites pour l'assimilation de la technologie nouvelle.

C'est pour ces très importantes considérations qu'il est impératif d'élaborer une Politique nationale des sciences et de la technologie. Cette Politique s'efforcerait d'atteindre les objectifs suivants:

- Rétablir la compétitivité de l'économie canadienne et accroître sa productivité sur le plan international.

- Prendre les initiatives nécessaires et indiquer les lignes de conduite à suivre en matière scientifique et technique.

- Mettre en évidence les lacunes existantes et les possibilités offertes au sein de l'infrastructure scientifique et technologique du Canada.

- Tenir compte des priorités de l'économie de chaque province ou territoire, et tirer parti des possibilités qu'elle offre.

- Tracer un cadre pour la prise en compte des considérations scientifiques et techniques dans l'élaboration des politiques et des stratégies concernant les domaines adjacents.

Il faut dresser le plan d'élaboration d'une Politique nationale des sciences et de la technologie afin de guider les débats visant à circonscrire ses objectifs. Ce plan s'insérerait dans un programme de mise en oeuvre des décisions cruciales prises au sujet des grandes questions posées.

Voici celles qu'il faudra évaluer:

- **Comment le Canada peut-il acquérir et développer du mieux possible les connaissances nouvelles?**

- **Comment les Canadiens peuvent-ils mettre ces connaissances à profit et tirer efficacement parti des possibilités qui se présentent?**

- Comment les Canadiens peuvent-ils mieux s'adapter aux changements qu'apportent les sciences et la technologie?

- Comment concerter la mise en oeuvre d'une Politique nationale des sciences et de la technologie?

Nous allons envisager chacune de ces questions dans la section qui suit.

Le plan d'élaboration de la Politique nationale des sciences et de la technologie

1. L'acquisition et le développement de nouvelles connaissances

C'est le potentiel de recherches fondamentales de nos universités et des laboratoires fédéraux qui constitue le facteur crucial de l'acquisition et du développement des nouvelles connaissances. Toute généralisation est malaisée, en raison de l'hétérogénéité du secteur universitaire, mais il faut cependant prendre note de certains de ses aspects. Bien que plus de 70 établissements post-secondaires confèrent des diplômes au Canada, un nombre d'entre eux n'accomplissent pas de véritable programme de recherche. De plus, sur les trente universités en tête de la liste de celles qui en font, quatorze réalisent 75 pour cent de la recherche commanditée dans les établissement d'enseignement post-secondaire. Ce sont ces universités "axées sur la recherche" qui obtiennent les fonds des conseils subventionnaires, des administrations provinciales et des entreprises du secteur privé.

Les effectifs hautement qualifiés et la recherche fondamentale

Les effectifs de recherche et développement de nos établissements post-secondaires sont restés remarquablement stables depuis 1963, année où la dotation était de 13 150 années-personnes, jusqu'à 1983, où elle a atteint 13 630 années-personnes. On peut se demander si ces effectifs sont suffisants pour satisfaire les besoins croissants de formation et de recyclage de personnel hautement qualifié dans le secteur privé.

Pour faire face aux nécessités de la mise en oeuvre des technologies nouvelles lourdes de l'avenir, le Canada doit disposer d'effectifs suffisants de spécialistes qualifiés et formés. Le Conseil de recherches en sciences naturelles et

en génie a ainsi calculé que, si la croissance économique se poursuit à un rythme raisonnable jusqu'en 1990, le Canada aura alors besoin de 1 600 chercheurs nouvellement diplômés du 3e cycle pour mener à bien des programmes de R-D devant absorber 1,5 pour cent du PNB. Nos universités ne disposent actuellement que de la moitié à peine de ces effectifs de formation supérieure. Les autorités doivent également se préoccuper du nombre d'enseignants nécessaires pour former les étudiants en sciences et en génie se destinant à des carrières industrielles dans certains domaines scientifiques d'avenir. La fourniture d'un soutien stable et suffisant à nos effectifs de chercheurs dans les domaines fondamentaux présente quelques défis à tous les responsables.

- Il est indispensable d'améliorer à long terme l'enseignement des sciences à tous les paliers de l'appareil scolaire, et particulièrement, comme le Conseil des sciences du Canada l'a montré, dans les écoles primaires et secondaires, et d'encourager un plus grand nombre d'élèves, en particulier de filles, à étudier les disciplines pertinentes.

- Il faut accroître le potentiel de R-D des établissements d'enseignement post-secondaire, afin de maintenir le pouvoir concurrentiel du Canada au sein des pays développés. Le Conseil des ministres de l'éducation a pris conscience de cette nécessité, et il a demandé aux autorités provinciales et territoriales de relever le défi.

- Un risque apparenté (quoique encore non prouvé) est celui du départ éventuel de nombre de nos jeunes chercheurs vers des horizons plus prometteurs. Selon des statistiques récentes de la National Science Foundation, si l'on suppose que le déplacement se fait surtout vers les États-Unis, le nombre de scientifiques et d'ingénieurs nés au Canada ou dont le dernier pays de résidence permanente était le Canada diminue, en fait, depuis 1982. Par ailleurs, les chiffres à eux seuls ne peuvent exprimer exactement la valeur des individus qui ont quitté le Canada; ce facteur doit être étudié de près.

Une analyse récente du CRSNG au sujet des capacités de financement de leur effort d'enseignement et de R-D par les universités a montré qu'entre 1970 et 1983-84 elles ont subi une réduction réelle de leurs crédits, et que c'est la compression du financement des biens d'équipement qui est le principal facteur de ce déclin des efforts.

Le secteur de l'enseignement supérieur n'a pas été le seul à se plaindre de ces compressions. De nombreux organismes, y compris le Conseil des sciences du Canada, la Chambre de commerce du Canada, l'Association des manufacturiers canadiens et certaines entreprises de pointe, telles que Northern Telecom et SED Systems, ont exprimé fortement leurs préoccupations au sujet de la crise financière que traversent beaucoup d'universités candiennes, M. David G. Vice, président de Northern Telecom Ltd. a déclaré récemment ce qui suit:

> "C'est toutefois sur la modernisation de nos installations de recherche universitaire que repose le rajeunissement de nos industries." Ces institutions occupent une place cruciale, la triade de la recherche étant composée des laboratoires privés, des installations gouvernementales et des institutions post-secondaires. Les laboratoires universitaires peuvent et devraient être les chefs de file dans le domaine de la recherche fondamentale. Qui plus est, les institutions post-secondaires restent la principale source où une société dynamique puise ses spécialistes".

Comme M. Vice le soulignait plus haut, le Canada doit rivaliser avec d'autres nations utilisant matière grise et savoir-faire nouveau dans un monde de plus en plus turbulent et concurrentiel. La recherche fondamentale, par exemple, prend une importance de plus en plus déterminante aux États-Unis, en Grande Bretagne et au Japon.

Au Canada, on tient compte de ces faits nouveaux. Dans son plus récent budget, le gouvernement fédéral a annoncé une augmentation des crédits aux trois conseils subventionnaires, pour un montant éventuel d'un milliard de dollars au cours des cinq prochaines années, sous condition partielle que le secteur privé ferait aussi un effort financier. Cette initiative est importante sous plusieurs aspects. Elle fournit aux conseils subventionnaires une base stable pour accorder des subventions au cours des cinq prochaines années, et assure donc la collectivité des chercheurs qu'il est possible d'obtenir un financement stable à long terme. En second lieu l'engagement, par le gouvernement fédéral, d'un montant aussi important en période de difficultés budgétaires met en évidence sa prise de conscience de la nécessité de maintenir le dynamisme de l'infrastructure de la recherche. En troisième lieu, la formule de financement favorisera la collaboration entre industries et universités, et par conséquent la diffusion des connaissances nouvelles.

On remarque également que certaines administrations provinciales renforcent activement leur infrastructure de recherche. Le gouvernement du Québec, par exemple, consacrera au cours des cinq prochaines années, environ 75 millions de dollars à la mise sur pied de quarante équipes de recherche de masse critique dans les universités québécoises. Au Québec, les deux autres principales sources de financement de la recherche universitaire, c.-à-d. les conseils de subvention de la recherche scientifique et médicale (FCAR et FRSQ), on versé au total 51,5 millions de dollars en 1985-1986. L'octroi de 300 millions de dollars à la recherche médicale par l'Heritage Foundation for Medical Research de l'Alberta est un autre exemple marquant d'aide au lancement de recherches médicales de niveau international. La Fondation a réussi à attirer dans les universités de Calgary et de l'Alberta plus de 85 de ses scientifiques médicaux, sous l'autorité desquels travaillent plus de 300 étudiants supérieurs et post-doctoraux. La Fondation espère également établir une industrie médicale qui aurait son centre d'opérations en Alberta.

Les couplages entre industries et établissements post-secondaires

Le recueil des connaissances nouvelles exige, non seulement l'utilisation des ressources des universités canadiennes, mais aussi la concertation de l'action de différents secteurs. Les interactions entre firmes industrielles et universités concrétisent excellemment cette nouvelle collaboration. L'annonce récente, par le gouvernement fédéral, qu'il co-financerait la recherche universitaire à parts égales avec l'industrie, sous forme de contributions aux conseils subventionnaires, constitue la dernière en date d'une série d'initiatives visant à resserrer la collaboration entre les universités et les entreprises industrielles.

Le "Forum Entreprises-Universités" est un organisme au sein duquel se retrouvent les chefs de l'administration des principales entreprises du Canada et les présidents de la plupart des universités axées sur la recherche; cet organisme estime que les entreprises canadiennes ont accordé à la R-D universitaire un montant de 52 millions de dollars en 1984. Cette somme atteint 2 pour cent des dépenses de R-D des entreprises en un peu moins de 1 pour cent de l'ensemble des dépenses des universités.

En dépit de l'ampleur assez faible de ce montant, le nombre des ententes de coopération intersectorielle est impressionnant. Le Centre for Cold Ocean Resources

Engineering à Saint-Jean de Terre-Neuve, la Veterinary Infectious Disease Organization à Saskatoon et le Centre for Frontier Engineering Research à Edmonton sont d'excellents modèles expérimentaux innovateurs qui, grâce à l'aide de fondations privées et au soutien de l'État et de l'industrie, travaillent à des projets de recherche appliquée avec des chercheurs universitaires. Un autre exemple précis est l'Institut national de la recherche scientifique - Télécommunications, qui oeuvre de concert avec les laboratoires Recherches Bell-Northern à Montréal et offre aux diplômés d'universités des programmes menant à un grade.Mentionnons aussi la création de chaires universitaires de recherche industrielle et de programmes de cours et stages alternés, l'ouverture d'instituts de recherche industrielle, de centres d'innovation, de centres de technologie de pointe, de bureaux de diffusion de savoir-faire technique et d'autres organismes semblables en sont des exemples. Cependant, les efforts accomplis sur ce plan suscitent de sérieuses questions au sujet des rôles respectifs des universités et des entreprises industrielles.Les questions de conflits d'intérêts, de droits de propriété intellectuelle, d'évaluation des résultats de la recherche et de rôles stratégiques, entre autres, sont fort controversées. Plusieurs universités canadiennes, par exemple, se sont employées à mettre au point des stratégies et des lignes directrices pour traiter avec le secteur privé.

Les laboratoires fédéraux

Il faudra encore faire plus pour tirer parti des connaissances nouvelles acquises et développées par les laboratoires fédéraux et les organismes provinciaux de recherche. L'administration fédérale gère plus de 200 laboratoires éparpillés d'un océan à l'autre, et dont le budget annuel atteint environ 1,6 milliard de dollars. Quelques 8 100 scientifiques oeuvrent dans ces laboratoires, avec un personnel auxiliaire de 17 000 travailleurs. Les initiatives de développement technologique prises par certains de ces organismes, tel que le Conseil national de recherches du Canada et les laboratoires CANMET du ministère de l'Énergie, des Mines et des Ressources, ont produit des résultats valables.

Le Conseil des sciences du Canada a souligné que les laboratoires fédéraux ont été créés à des époques diverses, pour atteindre des objectifs différents et, à mesure que le temps passait, leurs activités devenaient parfois vagues et dispersées, et ne convenaient plus aux besoins du moment. Le Groupe de travail Wright a proposé dans son rapport, d'évaluer en profondeur les activités de ces laboratoires,

et de demander à leurs dirigeants de prouver leur utilité et la pertinence de leur action. Le Groupe de travail chargé de l'examen des programmes a réalisé une partie de ce travail, et a cerné les domaines où il serait possible d'améliorer la diffusion des connaissances nouvelles. Les laboratoires fédéraux ont entrepris de relever ce défi, et s'occupent d'évaluer les moyens grâce auxquels ils pourraient améliorer leur performance et répondre plus utilement aux besoins de leur clientèle.

Le Conseil national de recherches, par exemple, a axé son dernier plan quinquennal sur l'encouragement et l'aide qu'il pourrait fournir aux industries canadiennes désireuses de mettre en oeuvre de nouvelles solutions techniques à leurs problèmes. Dans son programme de recherche remanié, le ministère des Communications attache une très grande importance aux secteurs où les exigences du gouvernement en matière d'efficacité interne ou d'amélioration du service au public créent des possibilités de travail en commun avec les universités et le secteur privé, en vue d'élaborer de nouvelles techniques selon des méthodes originales d'organisation et de perfectionnement des ressources humaines.

Les centres de technologies

On évalue également la pertinence des centres de technologie qui offrent leurs services aux diverses industries dans tout le Canada. Ce sont la taille insuffisante et le morcellement de leurs activités qui constituent les principaux problèmes des plus récents de ces centres techniques spécialisés. Les chefs d'industrie ont fortement critiqué ce dernier aspect, en soulignant que les gouvernements devraient réserver leurs ressources aux centres d'excellence plutôt que de continuer à financer des centres de taille insuffisante, en se fondant sur des raisons économiques et techniques peu pertinentes. L'Administration fédérale, par le truchement du MEST, fait rechercher des méthodes efficaces de rationalisation de l'activité de ces centres de technologie, et de meilleurs modes de diffusion des techniques nouvelles.

Plusieurs administrations provinciales ont créé nombre de centres à vocation spécifiquement technique qui ont pour but d'aider à la diffusion de renseignements techniques aux clients. L'Ontario et le Québec ont été particulièrement dynamiques à cet égard. De plus, les huit organismes provinciaux de recherches, dont les budgets atteignent un total de 125 millions de dollars, et qui emploient 1 800 personnes, pouraient offrir plus largement aux petites et moyennes entreprises l'aide de leurs spécialistes. Les organismes provinciaux de recherches sont aussi une

importante ressource de développement régional, ainsi qu'un excellent exemple de collaboration fédérale-provinciale et interprovinciale pour ce qui est de donner une aide technique générale à de nombreux clients partout au Canada. Et il ne faut pas oublier leur capacité de tirer parti des compétences techniques étrangères. Par exemple, les huit organismes provinciaux de recherches viennent de terminer une importante mission en Allemagne de l'Ouest, au cours de laquelle ils seront réunis avec plus de trente établissements de recherche. Par suite de ces rencontres, plusieurs organismes provinciaux de recherches ont conclu des ententes informelles d'échange de projets et de renseignements techniques pour aider les entreprises canadiennes.

Situation du Canada sur la scène mondiale des sciences

Les scientifiques canadiens rédigent environ 4 pour cent de la documentation scientifique mondiale, et développent environ 2 pour cent des techniques nouvelles. C'est pourquoi notre pays tire une large part des connaissances qui lui sont nécessaires de son réseau international d'échange scientifique et technique. Certains craignent que l'activité du Canada en quelques domaines scientifiques ne soit en train de se renverser. Notre part de publications scientifiques à l'échelle mondiale, bien qu'elle soit un indice partiel et toujours controversé de l'activité scientifique au Canada, a diminué de 1973 à 1982. Par exemple, les établissements de recherches canadiens sont à l'origine de dix des cent articles de chimie publiés en 1982, et les plus cités entre 1982 et 1984. Les scientifiques du Centre d'études supérieures en chimie Guelph-Waterloo ont rédigé six de ces articles. C'est là un fait encourageant; cependant, d'autres domaines de recherches sont en péril. Par exemple, le Conseil de la science et de la technologie du Québec évalue actuellement le dynamisme de la biologie végétale dans cette province, en raison des dommages que son déclin éventuel pourrait causer au développement ultérieur de la biotechnologie.

Les connaissances technologiques étrangères

Les connaissances techniques mondiales proviennent, en grande partie, de l'étranger. Pour que le Canada puisse progresser voire survivre dans l'ère technologique, il faut que nos relations internationales en matière de technologie visent d'abord et avant tout à favoriser et à faciliter l'acquisition de techniques étrangères par les éléments productifs de l'économie canadienne, notamment le secteur privé. Plusieurs moyens peuvent être employés à cette fin, dont les missions à caractère technique, les accords

d'échange, l'affectation d'agents techniques à des postes canadiens à l'étranger, et des programmes tels que le nouveau Programme d'apports technologiques (PAT), quoique ces instruments devraient être renforcés. Il faut, par-dessus tout, que les entreprises et les organismes techniques canadiens soient bien renseignés sur les techniques nouvelles et y aient accès. Dans le domaine de l'intelligence artificielle, par exemple, le Canadian Society for Fifth Generation Research a conclu un protocole d'entente avec le Japon, prévoyant l'échange de personnel de recherche et de données.

Les brevets sont un autre moyen d'accès aux connaissances techniques de l'étranger. Mais l'utilisation à peu près nulle de l'information à ce sujet par les entreprises et les établissements de recherche canadiens réduit l'efficacité de l'exploitation des techniques étrangères. D'après une étude menée par le U.S Patent Office, 70 pour cent des articles brevetés aux États-Unis n'avaient pas été décrits ailleurs dans les cinq années suivant l'octroi des brevets. Dans un pays comme le Canada, où la plupart (94 pour cent) des brevets nationaux sont accordés à des requérants étrangers, la diffusion efficace des renseignements techniques contenus dans les brevets canadiens aiderait énormément à accroître la productivité et le pouvoir de concurrence des entreprises canadiennes.

Au cours des dernières années, le Bureau canadien des brevets d'invention a entrepris de promouvoir la diffusion des connaissances technologiques canadiennes et étrangères, en offrant un service de recherches techniques aux petites entreprises manufacturières, par le biais d'un réseau national d'intermédiaires composé d'organismes provinciaux de recherches, de centres d'innovation et de divers organismes fédéraux et provinciaux.

Il y a un autre facteur qui est intimement lié et tout aussi essentiel à la question des connaissances techniques étrangères, c'est-à-dire la solution nécessaire du problème croissant de protectionnisme en matière de technologie, causé par l'accès restreint aux connaissances techniques étrangères. Bien qu'il touche le monde entier, ce problème affectera le Canada, surtout dans ses négociations commerciales bilatérales actuelles avec les États-Unis. Le Conseil des sciences du Canada vient de diffuser une déclaration qui souligne la nécessité d'accorder la priorité à la technologie dans ces négociations commerciales. Le Conseil suggère plusieurs moyens à cet effet et recommande que les négociateurs accordent suffisamment d'attention aux retombées du libre-échange sur la R-D au Canada, et aux mesures essentielles de promotion des compétences techniques.

De toute évidence, la question du libre-échange préoccupe beaucoup les administrations publiques. Par exemple, les politiques canadiennes d'approvisionnement dans certains domaines ont déjà été contestées au cours des discussions préliminaires que le Gouvernement des États-Unis a entamées en prévision de la prochaine série de négociations multilatérales du GATT. La question de l'inclusion prioritaire de la technologie dans les négociations commerciales est donc très complexe et très importante. Plusieurs associations industrielles, dont l'Association candienne de technologie avancée, se sont activement employées à exprimer clairement leur position à cet égard.

Dans une perspective plus vaste, certaines questions fondamentales doivent être abordées en ce qui concerne l'accès aux techniques étrangères et l'acquisition de ces techniques - par exemple, l'équilibre entre le soutien nécessaire des compétences canadiennes de R-D et le soutien de nos capacités d'intégration des techniques étrangères. C'est une question très complexe, qui nécessite un examen minutieux de l'infrastructure scientifique et technologique globale du pays. Par exemple, selon un commentateur de l'OCDE qui traitait du succès des politiques techniques des États-Unis et de plusieurs pays d'Europe, environ 5 pour cent des ressources techniques d'un pays pourraient être affectées à l'élaboration de nouvelles techniques, et le reste à la diffusion de ces techniques ou à leur intégration dans les pratiques commerciales courantes.

Les technologies stratégiques

Il faudra aussi que les Canadiens choisissent soigneusement, pour les développer et les mettre en oeuvre, les sciences émergentes et les technologies d'importance stratégique pour le pays. Bien que le Canada dispose d'un certain potentiel de recherches dans le groupe central de technologies en développement rapide, telles que la microélectronique, la biotechnologie et la création de matériaux industriels de pointe, de nombreux observateurs estiment que l'infrastructure correspondante est trop fragile, et qu'il faudrait lancer une action nationale pour la renforcer.

Dans quelques technologies particulières, les Canadiens progressent relativement bien. D'après une enquête à l'échelle du pays, entreprise par le Conseil des sciences du Canada au sujet des technologies émergentes, le Canada se trouve parmi les chefs de file mondiaux en matière de télécommunications, et techniques améliorées de récupération de pétrole, de carburants synthétiques, de télédétection, de logiciels et de techniques d'utilisation de l'hydrogène. Il

dispose également de potentiels de recherche notables dans les domaines des alliages inédits, des stratifiés, des matérieux conducteurs, de l'utilisation du charbon, de l'ingénierie des glaces et des techniques de construction. Cependant, dans le domaine des grandes technologies facilitatrices, l'effort canadien de développement est insuffisant, et il est écartelé sur le plan géographique.

Il faut explorer ces domaines et d'autres de façon plus complète afin que notre pays puisse acquérir et développer les connaissances nouvelles cruciales pour la viabilité de son économie. Il nous fait comprendre, non seulement les traits structuraux et organisationnels des sciences et de la technologie, mais aussi leurs aspects culturels, tels les conséquences du biculturalisme pour la recherche, le cas spécial du Nord, et le rôle de la sensibilisation du public. Le Conseil de la science et de la technologie du Québec a été particulièrement clair sur la première de ces questions, dans son rapport de conjoncture de 1985, et a étudié très abondamment les distinctions entre les systèmes de recherche des universités anglophones et francophones du Québec. Le Nouveau-Brunswick et l'Ontario s'intéressent aussi à cette question. Au Nouveau-Brunswick, par exemple, l'élaboration et l'application de programmes d'aide technique dans les deux langues officielles, par le biais du réseau universitaire de cette province, pose d'importants défis aux établissements visés. Comme un observateur avisé l'a souligné, la situation de notre pays est unique, en raison du comportement distinctif de ses établissements scientifiques et technologiques.

Récapitulation des questions qui se posent

Les questions évoquées ci-dessus mettent en évidence les divers éléments nécessaires pour acquérir et développer les connaissances nouvelles. Elles concernent l'enseignement des sciences, les effectifs hautement qualifiés et le rôle des universités en matière de recherche fondamentale, les couplages entreprises-universités, le complexe des laboratoires fédéraux, les centres de technologie, la place du Canada sur la scène scientifique mondiale, l'acquisition de connaissances techniques à l'étranger et le développement des technologies stratégiques au pays même. Plusieurs questions cruciales sont évoquées par le contexte actuel. En voici quelques-unes :

- **Quelles mesures doit-on prendre pour renforcer l'infrastructure de la recherche scientifique et technologique dans les établissements post-secondaires canadiens?**

- Comment encourager le secteur privé à s'intéresser plus activement aux établissements de recherches financés par le secteur privé?

- Comment devrions-nous renforcer les mécanismes existants pour faciliter l'acquisition des connaissances techniques étrangères par les éléments productifs de l'économie canadienne?

- Que peut-on faire pour améliorer la collaboration entre les entreprises et les universités?

2. Mettre des connaissances à profit et saisir des possibilités

L'innovation technique a joué un rôle de plus en plus important, tant au Canada que chez ses concurrents principaux, en alimentant la croissance économique. L'utilisation des connaissances nouvelles pour tirer parti des possibilités qui se présentent dépend largement du dynamisme et de l'esprit d'entreprise du secteur privé, moteur de l'économie canadienne. Dans tout pays, le climat de l'innovation est déterminé par plusieurs facteurs: caractéristiques structurales de l'économie, attitudes sociales à l'égard des sciences et de la technologie, infrastructure S-T existante, incitations générales à l'innovation et potentiel de l'entreprise individuelle. Malheureusement, au Canada, chacun de ces facteurs montre des faiblesses. Le tableau I présente les performances de notre pays dans un certain nombre d'activités indicatrices, par comparaison aux autres pays de l'OCDE.

TABLEAU I

Activités indicatrices	Rang du Canada parmis les pays de l'OCDE
DIRD/PIB	10^{e}
R-D/Chiffre d'affaires dans la branche:	
- des produits chimiques	8^{e}
- du matériel électrique	6^{e}
- aérospatiale	5^{e}
- des composants électroniques	4^{e}
- des médicaments et médecine	7^{e}
- des instruments	9^{e}
Proportion des scientifiques et d'ingénieurs en R-D	7^{e}
Créativité	8^{e}
Productivité	7^{e}
Part du marché des exportations en produits à forte valeur ajoutée des pays de l'OCDE	8^{e}
Dépenses des entreprises en R-D / PIB	10^{e}

Source: données les plus récente de l'OCDE

Caractéristiques structurelles de l'économie

On blâme souvent les caractéristiques structurelles de l'économie pour les efforts insuffisants des entreprises en R-D et en sciences et technologie. Le Canada se place au 10^{e} rang des pays de l'OCDE pour le pourcentage du PIB consacré à l'effort de R-D accompli et financé par les entreprises industrielles en 1982 (voir le tableau II). L'économie du Canada se distingue par une proportion notable d'entreprises de propriété ou de direction étrangères, qui l'on transformée en vassale dépendant très largement de l'effort de R-D accompli à l'étranger. L'infrastructure de fabrication se trouve dans le coeur géographique du Canada; en conséquence, la politique du développement industriel a dû prendre en considération les questions de diversification et d'équité interrégionale. Ces facteurs, ainsi que l'attitude craintive des entreprises à l'égard du risque, obligent le Canada a remédier à l'insuffisance de l'effort financier en R-D et en innovation afin de prendre sa place dans l'économie mondiale.

TABLEAU II

	DIRD/ PIB (1984)	DIRD/ PIB (1982)	DIRD financé par entreprises du secteur privé en % du PIB (1982)	DIRD accompli par entreprises du secteur privé en % du PIB (1982)
Canada	1,35	1,36	0,52	0,65
États-Unis	2,70	2,66	1,33	1,94
Roy.-Uni	2,27[1]	2,42[2]	1,00[2]	1,50[2]
Allemagne	2,58[1]	2,58	1,47	1,80
France	2,22	2,10	1,47	1,21
Suède	2,47[1]	2,22[2]	1,27[2]	1,48[2]
Suisse	2,28[1]	2,29[2]	1,56[2]	1,70[2]
Japon	2,61[1]	2,47	1,57	1,53
Autriche	1,25	1,22	0,59[2]	0,65[2]
Pays-Bas	2,00	1,98	0,89	1,02
Norvège	1,41[1]	1,29[2]	0,52[2]	0,67[2]

1) chiffre de 1983
2) chiffre de 1981

SOURCE: OCDE

Attitudes de la direction des entreprises à l'égard de l'innovation

Il est évident qu'au sein des grandes entreprises, l'opinion des cadres de direction à l'égard de la valeur de la recherche et de l'innovation laisse fort à désirer. Une étude récente réalisée par Arthur D. Little, Inc. au sujet des méthodes suivies par les entreprises en matière d'innovation a montré que les dirigeants des sociétés nord-américaines entretiennent de moindres espérances que leurs homologues européens ou japonais au sujet du rendement de l'innovation. Une des raisons citées est que ces cadres estiment que l'innovation ressort de la compétence des scientifiques et des spécialistes, et non des cadres d'exploitation. De nombreux cadres canadiens, en particulier, acceptent cette opinion. Un rapport sur la diffusion de la technologie nouvelle, publié en janvier 1986 par le ministère de l'Industrie, du Commerce et de la Technologie de l'Ontario, suggère que c'est la résistance au changement montrée par les cadres d'exploitation qui freine la modernisation technologique espérée des entreprises de fabrication de l'Ontario. Cette attitude se traduit par une indifférence générale des sociétés, et particulièrement les

petites entreprises, pour ce qui est de l'adaptation au changement par la formation des employés dans des compétences spécifiquement liées à leur travail. Un sondage mené en 1984 par la Commission de la main-d'oeuvre de l'Ontario signalait cette lacune. Selon le sondage, seulement 2,7 pour cent de tous les employés recevaient une formation régulière d'apprentissage ou de recyclage d'une durée d'au moins deux semaines. Environ 80 pour cent de tous les établissements ne parrainaient pas de programmes d'apprentissage ou de recyclage.

Évaluation du comportement du secteur privé en matière de sciences et de technologie

D'autres indices mettent en relief des constatations fâcheuses. Les dépenses du Canada en matière de R-D industrielle en 1981 le placent au septième rang des pays de l'OCDE, et au huitième en ce qui concerne sa part des exportations de produits à fort contenu en R-D; de plus, cette part décline. Le déficit de la balance commerciale canadienne au titre des produits de haute technologie (qui contiennent une forte valeur ajoutée) est la plus mauvaise de celles des pays du Sommet économique. Une analyse réalisé par le MEST a montré qu'en 1984 ce déficit atteignait 12 milliards de dollars, et qu'il continue à croître. Selon le Rapport sur la concurrence internationale rédigé par la Conférence européenne de 1985 sur le management, le Canada se place au 15^{e} rang parmi 22 pays en matière "d'orientation vers l'innovation", un indice de l'acceptation de la technologie nouvelle au sein de chaque pays. Le nôtre arrive au 17^{e} rang également pour "l'orientation vers l'extérieur", un indice de présence sur les marchés étrangers.

La plupart des industries du secteur des ressources - moteur des exportations de notre pays - ont souffert d'une réduction de leur part des marchés internationaux, due à la concurrence croissante des nouveaux pays industrialisés. Cependant, d'autres facteurs interviennent : subventions des pays étrangers à leurs industries, besoins en remplacement de certaines matières premières. Notre industrie hésite à adopter de nouvelles technologies permettant d'augmenter nos exportations de produits agricoles, de produits ligneux, de poissons et de minerais; cependant, dans le secteur minier, les intéressés ont mis au point de nouvelles activités telles que la télédétection des gisements, et la fabrication des cermets et des matériaux industriels de pointe.

La Conférence européenne sur le management a élaboré un indice de créativité fondé sur le nombre de brevets accordés

aux nationaux par 100 000 habitants; de 1980 à 1982, le Canada s'est placé au 8e rang des pays industrialisés. Dans le domaine de la biotechnologie, par exemple, le nombre de brevets accordés à des Canadiens est minuscule. Le Canada se place au 11e rang après des pays comme l'Italie, le Danemark, la Suède et les Pays-Bas pour certaines catégories de brevets accordés par les États-Unis de 1973 à 1983 dans les domaines intéressants la biotechnologie. La part de nos nationaux dans d'autres inventions brevetées est également faible en d'autres domaines de pointe comme les médicaments, la médecine, la bureautique et l'équipement de magasin.

Dans certaines branches, il n'existe guère de spécialistes. Lors du second relevé actuel de la R-D des entreprises, réalisé par la Conference Board of Canada, plus d'un tiers des dirigeants interrogés ont souligné la pénurie actuelle de chercheurs qualifiés. Ces pénuries sont encore plus sérieuses dans le secteur de la haute technologie, car elles sont signalées par 57 pour cent des dirigeants. On craint que ces difficultés ne s'accroissent au cours des cinq années à venir.

Au Canada, l'accès au capital-risque n'a pas été très encourageant. On espère toutefois que l'exonération fiscale des gains en capital accordée récemment par le gouvernement fédéral incitera les Canadiens à investir dans de jeunes entreprises innovatrices en pleine croissance. On a estimé que le total du capital-risque qui y a été investi en 1983 ne dépassait guère 100 millions de dollars. Moins d'un dixième de cette somme a été affecté au lancement d'entreprises. Presque 40 pour cent du capital-risque canadien est investi actuellement aux États-Unis. Le capital d'exploration et le financement de démarrage sont presque inexistants ici.

L'activité du secteur privé en sciences et en technologie doit être considérablement étendue, bien que les entreprises aient accru leurs efforts tant sur le plan du financement que sur celui de la réalisation de la R-D. Il faut les y encourager, car des études successives ont montré que les entreprises en tirent d'importants avantages secondaires, tout comme le pays. On estime que la collectivité retire des avantages sociaux atteignant de 50 à 100 pour cent de l'effort fait en R-D, et que les entreprises en retirent de 15 à 30 pour cent. De nombreux observateurs ont conclu que l'évolution technologique, particulièrement par le truchement de l'effort de R-D, a des effets très importants sur le taux d'augmentation de la productivité nationale. On a même montré que l'effort de R-D accompli dans un secteur produit des avantages pour les autres.

Les initiatives prises récemment pour relever ce défi

Dans le passé, les propositions faites pour remédier à la faiblesse de l'effort de R-D du secteur privé ont obtenu quelques succès. Le gouvernement a mis en place plusieurs programmes d'incitation fiscale en cette matière, et d'autres programmes sont à l'essai. L'octroi d'exclusivités mondiales de fabrication par les maisons-mères à leurs filiales canadiennes ont encouragé ces dernières à mettre en oeuvre des programmes de R-D. Des objectifs ont été définis pour relever le pourcentage du DIRD à la charge du secteur privé, encore une fois avec des signes d'amélioration. De nombreux observateurs ont critiqué notre régime des brevets qui doit protéger les droits de propriété intellectuelle; on en remanie donc les dispositions pour refléter le caractère dynamique des technologies nouvelles. Néanmoins, il faudrait que l'industrie fasse un plus grand effort en sciences et en technologie, dans certains cas avec la coopération des divers paliers d'administration.

Le secteur privé doit relever ce défi pour atteindre le succès, et il semble qu'il commence à agir. De concert avec les syndicats ouvriers, les entreprises ont créé le Centre canadien du marché du travail et de la productivité, en vue d'accroître la productivité des industries, leur pouvoir concurrentiel et le nombre des emplois.

Certaines sociétés de produits chimiques et pétroliers de l'Ontario ont récemment fondé l'Institut des sciences et de la technologie chimiques, en vue d'améliorer la compétitivité de leur branche industrielle. L'industrie forestière, agissant de concert avec les administrations publiques, s'est employée activement à développer des compétences de recherche, par l'établissement d'un centre de pâtes et papiers à l'Université de la Colombie-Britannique, qui a coûté 6 millions de dollars, et la mise sur pied d'une installation de recherches relevant de l'Institut canadien de recherches sur les pâtes et papiers, dans cette même Université, au coût de 15 millions de dollars.

Plusieurs sociétés se sont distingués dans les domaines de la technologie de pointe, notamment la technique spatiale et l'aéronautique et d'autres entreprises ont manifestement joué un important rôle de direction dans plusieurs autres domaines, dont la biotechnologie, la micro-électronique et les secteurs liés à l'énergie. On prévoit que les entreprises accroîtront de 11 pour cent leur effort de R-D en 1986, par comparaison avec l'année précédente. Ce sont là des indications positives.

En dépit de l'intérêt qu'on accorde actuellement aux petites entreprises, il ne faut pas négliger la contribution considérable des multinationales à l'effort scientifique et technologique du Canada. Selon un relevé effectué récemment pour l'Administration ontarienne, les multinationales font un effort de développement et d'adaptation de la technologie supérieur à la moyenne; elles suivent un modèle dynamique d'innovation et mettent en place des mécanismes précis en ce domaine.

Les deux paliers supérieurs de gouvernement accordent la priorité à l'attraction des capitaux étrangers à investir, et s'efforcent de supprimer les obstacles à la croissance économique, en offrant au secteur privé des possibilités d'y participer dans toutes les régions du Canada.

Les gouvernements n'utilisent pas assez les marchés publics pour encourager le développement technique, car les trois paliers d'administration dépensent annuellement 60 milliards de dollars pour l'achat de biens et de services. La politique des marchés publics, associée à une modification de la politique d'impartition, offrent d'intéressantes possibilités pour accélérer l'innovation industrielle. Le rapport du Groupe d'études des marchés publics, soumis au Groupe de travail chargé de l'examen des programmes, indique qu'il est possible d'accroître largement l'activité scientifique et technique que l'État impartit au secteur privé.

Les petites entreprises, en raison de leur agilité, occupent et élargissent souvent de nouveaux débouchés, et leur capacité à adapter l'innovation et à adopter des techniques nouvelles est l'un des facteurs stratégiques de la mise en oeuvre des connaissances. On observe de plus en plus la création de centres d'incubation des entreprises nouvelles et de conseils de technologie dans les grandes agglomérations du Canada. Discovery Parks en Colombie-Britannique, Saskatoon Innovation Place au Saskatchewan, et Sheridan Park en Ontario, sont des exemples de tels centres d'incubation; le Calgary Research and Development Authority et le Groupe d'action pour l'avancement technologique et industriel de la région de Québec (GATIQ) sont des exemples de conseils de technologie. L'Innovation and Entrepreneurial Management Corporation (TIEM) constitue un excellent exemple du centre de développement des petites entreprises, auxquelles il fournit toute une gamme de services : évaluation technologique, accès facilité au capital de démarrage et locaux pour les nouvelles entreprises. Les villes de Sydney, Saint-Jean de Terre-Neuve, Québec, Winnipeg et Vancouver disposent de tels centres.

Le secteur canadien des services, et particulièrement les cabinets d'ingénieurs-conseils, constitue une ressource précieuse. Le Canada possède quatre des vingt grands cabinets d'ingénieurs-conseils du monde. Ils se trouvent fort bien placés pour communiquer et diffuser les connaissances nouvelles.

Les Ententes de développement économique et régional, et leurs accords auxiliaires conclus entre les deux paliers supérieurs de gouvernement constituent des instruments fort utiles pour encourager la croissance économique, en collaboration avec le secteur privé. Les sommes engagées dans le cadre de ces accords atteignent 4 milliards, dont 0,5 G$ sont destinés à stimuler l'effort de R-D, la diffusion de la technologie nouvelle et l'innovation industrielle.

Mais des obstacles restent en place. Comment accroître, par exemple, le nombre d'entreprises industrielles canadiennes financièrement capables de développer la S-T? L'étroitesse de l'infrastructure de R-D du Canada est mise en évidence par la faible proportion des entreprises de fabrication (soit 970 sur 35 500) qui accomplissent cette R-D. Il faudra évidemment développer cette infrastructure.

Comment élargir la collaboration entre les entreprises et les établissements de recherche industrielle? La collaboration hors-concurrence des entreprises avec les établissements de recherche appliquée polyvalente est assez limitée. On en trouve cependant des exemples réussis dans les secteurs des pâtes et papiers, du soudage, du ciment, de l'acier et du gaz. La plupart de ces établissements de recherche appliquée polyvalente est assez limitée. On en trouve cependant des exemples réussis dans les secteurs des pâtes et papiers, du soudage, du ciment, de l'acier et du gaz. La plupart de ces établissements de recherche industrielle ont noué des liens étroits avec les universités et les laboratoires de l'État. La prise en considération des centres de technologie financés par l'État fournit l'occasion de renforcer leur collaboration avec les entreprises industrielles.

L'industrie canadienne a dû également améliorer l'efficacité de sa mise en oeuvre de la technologie nouvelle, "comme un élément de son pouvoir concurrentiel dans toute une gamme de secteurs industriels", comme le dit l'Association des manufacturiers canadiens. Il faut que le secteur privé consacre plus d'argent à la technologie. Voici ce que déclare l'AMC dans un document de travail récent, sous le titre "Improving Industrial Competitiveness":

> "Les entreprises concurrentes des pays industrialisés améliorent l'utilisation des connaissances techniques, et celles des pays nouvellement industrialisés emploient de plus en plus la technologie, outre leurs coûts de fabrication moindres. Bref, les industries canadiennes participent à une course globale à la technologie."

Il se peut, comme l'Étude ontarienne sur la diffusion de la technologie l'indique, que bien des entreprises ne soient pas encore désireuses d'employer des technologies nouvelles, peut-être parce que leurs dirigeants sont loin d'être convaincus qu'elles procureront des bénéfices suffisantes; ils peuvent estimer que leur personnel n'a pas les capacités d'utiliser ces technologies, ou ne pas savoir eux-mêmes comment gérer le changement. Dans tous les cas, il reste que nos entreprises industrielles doivent hausser leur niveau technologique, et qu'elles en partagent la responsabilité avec l'État.

Récapitulation des questions qui se posent

Dans la section ci-dessus, nous avons surtout porté notre attention sur le rôle du secteur privé en matière d'utilisation des connaissances nouvelles et d'exploitation des possibilités technologiques. Dans le passé, leurs efforts n'ont pas été suffisants pour diverses raisons, mais on note actuellement certains indices positifs qui montrent que ces entreprises relèvent le défi de la course mondiale à la technologie. Dans la plupart des pays occidentaux, de solides arguments sont en train de démontrer que pour accroître son développement technologique, un pays doit avoir une saine infrastructure scientifique intérieure. Voici les questions cruciales auxquelles il faut répondre :

- **Comment le Canada pourrait-il déployer ses ressources techniques dans les domaines stratégiques pour en tirer le maximum de bénéfices?**

- **Comment développer la collaboration entre les entreprises, les agents du progrès technique et les établissements de recherches?**

- **Quelles mesures pourraient assurer que les industries traditionnelles et celles utilisant la technologie nouvelle tirent efficacement parti de la diffusion des connaissances nouvelles, de leur développement, du transfert technologique, de l'aide financière et de l'ouverture des débouchés?**

3. Faire participer tous les Canadiens et s'adapter au changement

À cause de l'évolution si rapide de la société, causée par l'émergence des nouvelles technologies, il est devenu impératif qu'une Politique nationale des sciences et de la technologie sensibilise les Canadiens aux problèmes qui se posent et aux possibilités qui s'offrent. Mais sans disposer d'un potentiel technologique suffisant, il nous sera impossible de créer la prospérité et les emplois qu'attend la collectivité.

Tous les secteurs : administrations, entreprises, syndicats ouvriers et réseau d'enseignement assument des responsabilités sérieuses en matière de préparation de la société aux changements à venir. C'est ici que l'aspect humain de cette évolution prend toute son importance.

Les attitudes collectives face aux sciences et à la technologie

Il est important, dans le cadre de la sensibilisation du public, de savoir comment les observateurs attentifs considèrent les incidences quotidiennes du progrès scientifique et technique. L'attitude générale peut être influencée par les médias, l'éducation, les organismes de sensibilisation, l'opinion que le public se fait des scientifiques et des ingénieurs, et les décisions prises par les élus politiques. Les médias jouent, certes, un rôle crucial à cet égard. Pour que les Canadiens soient bien et suffisamment informés sur les retombées de la science et de la technologie sur leur vie de tous les jours, c'est, en partie, aux journalistes, écrivains, éditorialistes et animateurs scientifiques de télévision qu'ils le doivent. Un sondage mené récemment par l'Association des communicateurs scientifiques du Québec révèle de graves lacunes à ce chapitre. D'après ce sondage, l'information et les nouvelles scientifiques du domaine de la science et de la technologie n'occupent, en moyenne, au Québec, qu'un peu plus de 3 p. 100 de l'information diffusée quotidiennement dans la presse écrite et moins de 0,5 p. 100 à la télévision.

Les Canadiens, comme la plupart des autres gens, ont une attitude ambivalente au sujet des conséquences des progrès scientifiques et techniques. D'un côté, ils sont contents de recueillir les avantages que leur procurent les sciences et la technologie; de l'autre, ils craignent les conséquences des utilisations les plus malencontreuses de ces connaissances. Un sondage d'opinion mené au Québec a

montré, par exemple, que les Québécois reconnaissent l'influence bénéfique des progrès scientifiques et techniques sur leur confort, leur santé et la qualité de leur vie. Et pourtant, une majorité des gens interrogés estiment que les progrès scientifiques ont eu des effets clairement néfastes sur les perspectives de paix mondiale.

Les progrès techniques et le monde du travail

Le sondage effectué au Québec a aussi mis en relief une autre préoccupation cruciale : les conséquences de l'évolution technologique pour l'emploi. Les enquêteurs ont conclu que la moitié des personnes interrogées estiment qu'à long terme les changements technologiques créeront autant d'emplois qu'ils en feront disparaître, mais 40 pour cent des répondants sont d'opinion contraire. Vingt-six pour cent des personnes interrogées estiment qu'à moyen terme leur emploi risque d'être supprimé à cause des progrès techniques.

Le débat n'est pas clos. En 1985, le Groupe de travail ontarien sur l'emploi et les technologies nouvelles a montré que le niveau d'emploi et le revenu réel s'étaient accrus parallèlement à de notables changements technologiques. Une étude en cours de réalisation du Conseil économique du Canada confirme cette observation, et ses conclusions préliminaires montrent que, de 1971 à 1981, l'emploi dans les industries de pointe s'est accru à un taux beaucoup plus rapide que le taux moyen de croissance de l'ensemble de l'industrie. Cependant, le Conseil économique a fait immédiatement observer qu'il faut considérer ces tendances avec un optimisme prudent. Il faudra évaluer soigneusement les perturbations possibles et les nouveaux problèmes de santé et de sécurité entraînés par l'évolution technique. De plus, nous ne sommes pas encore capables de déterminer si le niveau technique des emplois concernés sera amélioré ou abaissé. Bien qu'il semble que les emplois du proche avenir ne nécessiteront pas de changement notable de la formation scolaire des demandeurs, la rapidité même de l'évolution technique exigera des gens qu'ils apprennent à s'instruire. Un récent sondage d'opinion au sujet des attitudes des travailleurs à l'égard de la nature de leur travail a indiqué qu'une meilleure formation leur paraît être la façon la plus judicieuse d'accroître la productivité.

Dans l'industrie, le problème est de retenir les ingénieurs et les scientifiques, et d'actualiser constamment leurs connaissances. Le risque de disparition des emplois périmés est très réel, et il s'accroîtra à mesure de l'accélération de l'innovation et du vieillissement de la

population active. Aux États-Unis, par exemple, la Lockeed Corporation a mis à l'essai un programme unique en son genre, Lending Employees for National Development (LEND), dans le cadre duquel les scientifiques et les ingénieurs qui, autrement, auraient été mis à pied, sont détachés auprès d'autres entreprises, tout en conservant les avantages acquis et les droits d'ancienneté dans leur firme d'origine. Il n'existe pas de tel programme au Canada, mais on pourrait étudier ce mécanisme intéressant, qui permet d'utiliser au maximum les talents des spécialistes.

Il faut aussi envisager une préparation efficace des cadres de gestion à la mise en oeuvre des technologies nouvelles dans leur entreprise, grâce à une approche plus éclairée. Ils ont l'importante tâche d'engager, de motiver et de retenir les spécialistes productifs qui assureront le dynamisme de l'entreprise. Cette charge nécessite une collaboration efficace de ces cadres d'entreprise avec les syndicats ourvriers et les autorités politiques, afin de faciliter l'évolution nécessaire. Il existe déjà des modèles d'une telle collaboration, tels le Centre d'innovation en milieu de travail, créé au Manitoba. Un autre exemple est celui du projet d'éducation en technologie du Congrès du travail du Canada qui a abouti à une série d'ateliers régionaux et à une conférence nationale en février dernier et qui a relevé plusieurs points nécessitent une attention collective. Entre autres, les mouvements syndicaux doivent renouveler leur engagement de faire du virage technologique une priorité et les organisations du monde du travail devraient constituer une banque centrale de renseignements sur le virage technologique où les divers mouvements syndicaux pourraient puiser pour leurs travaux. Le Ministère du travail a créé un Fonds de recherche sur les répercussions du changement technologique qui sert à financer les projets de recherche et de démonstration sur les répercussions sociales et humaines des progrès techniques sur le monde du travail.

Une société de culture scientifique

À long terme, d'autres possibilités apparaîtront, qui permettront de former une société aisément adaptable au changement, et aussi cultivée sur les plans technologique et scientifique.

Cette dernière perspective est largement répandue actuellement dans les pays les plus industrialisés. Au Canada, le Conseil des sciences a entrepris, en consultation

avec le Conseil des ministres de l'Éducation, une grande étude sur le dynamisme de l'enseignement de sciences dans l'appareil scolaire du pays. Le Conseil des sciences se préoccupe de la préparation insuffisante des jeunes à la vie et au travail dans la société techniquement complexe de demain. Le Conseil recommande qu'on donne un enseignement des sciences dans toutes les écoles primaires, qu'on encourage les filles à continuer leur éducation scientifique et technologique tout au long de leur scolarité, que les enseignants montrent comment les savants canadiens ont contribué aux progrès des sciences, comment celles-ci ont façonné la société canadienne, et comment on peut introduire l'enseignement technique dans les écoles secondaires. Ce sont là quelques-unes des principales recommandations de l'Étude qui, dans certains cas, a conduit les chercheurs à reconsidérer l'enseignement des sciences. Il faut que les générations futures soient mieux équipées pour vivre dans un monde technologique.

Plusieurs groupes du monde des affaires et de l'industrie ont également exprimé leurs opinions sur cette question primordiale. Ainsi, l'Association des manufacturiers d'équipement électrique et électronique du Canada a publié un mémoire prônant une culture technologique plus poussée au sein de la société canadienne afin d'obtenir les gens formés nécessaires à l'épanouissement des compétences scientifiques et technologiques canadiennes.

Le Forum Entreprises-Universités, dans une analyse toute récente qu'il avait appuyée au sujet des diplômés universitaires et des entreprises, abordait cette question sous l'angle d'un sondage afin de connaître la réaction des employeurs face à la qualité de l'enseignement universitaire. En général, les constatations étaient positives. Cependant, le rapport, dans ses conclusions préliminaires, avançait que les programmes d'études techniques ne devraient pas empiéter indûment sur les cours obligatoires en arts libéraux généraux dans les universités, et que les universités, de concert avec les entreprises, devraient initier un plus grand nombre d'étudiants du secteur technique aux innovations technologiques et aux perspectives internationales.

Récapitulation des questions qui se posent

Dans la section précédente, nous avons étudié certains des facteurs cruciaux de l'adaptation aux changements que les technologies nouvelles introduiront dans notre société. Elles auront des conséquences capitales pour les postes de travail, et sur l'ensemble de l'emploi. Un défi crucial de

notre temps est d'apprendre à s'instruire, et tous les secteurs de la société auront la responsabilité de s'assurer que les Canadiens sont convenablement préparés à l'évolution technologique. Il faudra accorder dans ce but une attention particulière à la sensibilisation du public aux programmes scientifiquement technologiques, et renforcer l'appareil canadien d'enseignement des sciences. Cette sensibilisation repose sur le rôle des musées des sciences, des organisations de jeunes scientifiques et pour l'avancement des sciences, et des numéros de vulgarisation des revues et journaux scientifiques. De même faudra-t-il aider la population active en général et les cadres de gestion à saisir les possibilités offertes par la technologie. Voici certaines des questions cruciales qui se posent :

- **Quelles mesures pourrait-on prendre pour améliorer la concertation des efforts des syndicats ouvriers et de la direction des entreprises pour la mise en oeuvre des technologies nouvelles?**

- **Comment améliorer l'action des organisations de sensibilisation du public en vue de promouvoir les sciences et la technologie?**

3. Mise en oeuvre d'une politique nationale des sciences et de la technologie

L'Organisation de coopération et de développement économique a mis en évidence trois éléments indispensables à la poursuite d'un renouveau économique grâce aux sciences et à la technologie :

1. Il faut tracer des axes précis pour l'effort technologique national.

2. Il doit exister une infrastructure solide pour l'accumulation et la diffusion des connaissances et du savoir faire technique.

3. Il doit exister des conditions favorables à l'innovation et à l'esprit d'entreprise.

Comme notre analyse précédente l'a montré, la mise en oeuvre d'une stratégie nationale exige une solide infrastructure d'acquisition et de développement des connaissances, et de mise en oeuvre de ces connaissances pour l'exploitation des possibilités qui se présentent et pour gérer l'adaptation de la société à l'évolution technologique.

Concertation d'un effort national

Il sera indispensable de mettre en place un mécanisme efficace de direction de l'effort technologique national. L'adoption d'une Politique nationale des sciences et de la technologie fournira le cadre où s'insèreront les divers programmes fédéraux et provinciaux portant sur l'innovation et la recherche, et les politiques pertinentes. Il faudra que cette Politique délimite ses objectifs cruciaux.

Pour diriger les efforts le long des axes privilégiés, le Canada a besoin d'un programme et d'un potentiel intégrés, afin de répartir ses ressources en S-T dans les domaines stratégiques et de maximiser les avantages. Dans le domaine de la biotechnologie, par exemple, on a consacré de gros efforts à l'élaboration de la stratégie nationale pertinente associant les grands acteurs de ce domaine spécialisé grâce à plusieurs réseaux. Pour rivaliser avec d'autres pays qui ont mis sur pied des efforts concertés dans les domaines stratégiques, le Canada doit tracer un cadre général pour le développement d'autres technologies d'importance pour lui, telles que les technologies informatiques, la création de matériaux de pointe, l'optoélectronique, l'intelligence artificielle, la télédétection et les nouvelles techniques de construction.

Après une évaluation convenable et la mise en évidence de créneaux commerciaux, l'utilisation industrielle de ces nouvelles technologies faciliterait la création d'entreprises et le développement de nouvelles branches industrielles, comme parfois c'est déjà le cas. Ce développement jouera également un rôle vital en aidant les entreprises existantes des secteurs d'exploitation des ressources et de la fabrication.

Il faudra que les autorités publiques, les universités et le secteur privé précisent leurs rôles respectifs dans le développement des technologies stratégiques, et se concertent pour y parvenir.

Utilisation de l'infrastructure existante

Il faut également que nous apprenions à nous servir de ce qui est déjà en place. L'infrastructure scientifique et technologique du Canada représente un investissement important en matière grise. Il faut nous efforcer de la mobiliser pour atteindre les objectifs nationaux. Par chance, nous disposons d'excellents exemples de réseaux en place. Le Programme d'aide à la recherche industrielle du Conseil national de recherches englobe un vaste réseau de

ressources techniques qui, de concert avec les organismes provinciaux de recherches, les centres universitaires de technologie et les cabinets d'ingénieurs-conseils fournissent une aide précieuse aux entreprises industrielles de notre pays.

Les universités canadiennes s'efforcent de réunir des moyens atteignant la masse critique grâce à des initiatives communes et à des associations ad hoc. La Société canadienne de la microélectronique en constitue un exemple bien connu, mis sur pied par le Conseil de recherches en sciences naturelles et en génie pour aider les universités canadiennes à mener à bien des recherches et des études sur tous les aspects de la conception des circuits intégrés. Parmi d'autres exemples, citons les divers organismes coopératifs de recherche industrielle, tels que l'Institut canadien de recherches sur les pâtes et papiers, l'Institut de soudage du Canada et la Canadian Steel Industry Research Association. L'établissement d'un réseau de chercheurs constitue un objectif précis de l'Institut canadien des recherches avancées. L'Institut réunit les talents des chercheurs canadiens qui s'adonnent à des travaux précis dans des domaines tels que la robotique et la recherche spatiale.

Ces organismes, comme d'autres, constituent des modèles valables de collaboration au sein des branches industrielles et entre l'industrie, les laboratoires publics et les universités. Il faut les encourager et les multiplier.

La mise en place de conditions favorables

La mise en place d'un climat favorable à l'innovation et à l'esprit d'entreprise constitue le troisième facteur indispensable à un effort national en S-T. Il faudra tracer un cadre précis pour la concurrence et la collaboration entre industries, apporter des réformes judicieuses à la réglementation, fournir des incitations et un soutien aux innovateurs et éliminer les obstacles organisationnels, administratifs et autres qui freinent le développement d'un esprit d'entreprise dynamique dans notre pays.

Il faudra prendre des décisions cruciales dans les domaines de la stratégie commerciale, de la politique fiscale, de la politique des marchés publics, de l'aide en capital-risque et des subventions à la R-D. Il faudra, après, en exercer un contrôle suivi et en faire l'évaluation soutenue.

Il est nécessaire de mettre en place un ensemble de conditions favorables pour stimuler le renouvellement de l'économie. C'est ainsi que le gouvernement fédéral s'occupe de renforcer ses programmes d'incitation fiscale et de subventions à la R-D de l'industrie. Il cherche à mettre sur pied un mécanisme rationalisé et simplifié de soutien de la R-D, et il y a combiné les aides fiscales et non fiscales pour convenir aux besoins divers des petites, moyennes et grandes entreprises. Le gouvernement cherche également à simplifier les activités de R-D industrielle du secteur public pour les rendre plus efficaces et plus accessibles. Il consulte les gouvernements provinciaux pour concerter cet effort avec les programmes provinciaux et les mesures prises à ce niveau. En outre, le MEST participe activement à l'étude de mécanismes permettant d'améliorer la diffusion de la technologie nouvelle au Canada, et il a récemment achevé une analyse de la situation.

Le créneau dont le Canada dispose pour la mise en oeuvre d'une Politique nationale des sciences et de la technologie ne restera pas ouvert très longtemps. Les activités internationales en sciences et en technologie, en particulier, le resserrent graduellement. Il nous faut agir dès maintenant et rassembler les ressources et la matière grise qui permettront au Canada de renouveler son économie. Nous devons avoir une image collective de la place du Canada dans l'économie mondiale et cerner les objectifs de notre assaut technologique.

Récapitulation des questions qui se posent

Dans cette section finale, nous avons passé en revue certains atouts du Canada dans les domaines scientifiques et techniques, et proposé un plan pour grouper ces ressources dans le cadre d'une Politique nationale des sciences et de la technologie. Voici les questions auxquelles il faudra répondre:

- **Comment nous assurer que les diverses régions du Canada tireront les avantages voulus des technologies nouvelles.**

- **Quels devraient être les rôles respectifs et les responsabilités des autorités publiques, du secteur privé, des universités et des syndicats ouvriers dans la mise en oeuvre d'une Politique nationale des sciences et de la technologie?**

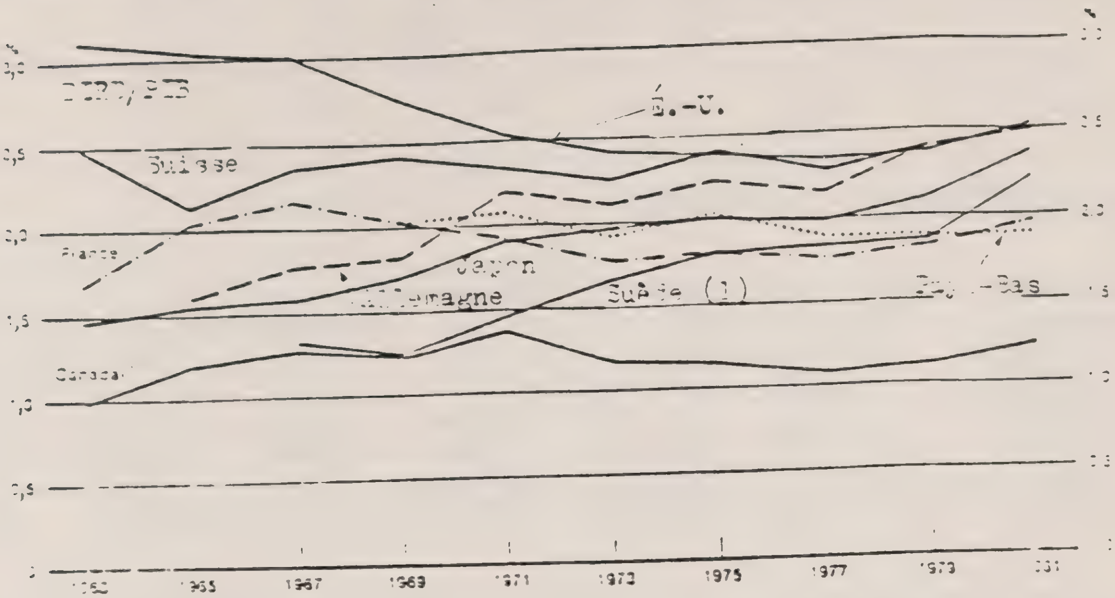
- **Quelle serait la valeur d'objectifs bien circonscrits pour guider la mise en oeuvre d'une Politique nationale des sciences et de la technologie?**

- **Quels seraient les mécanismes permettant d'assurer une coordination permanente de l'action des diverses parties intéressées, et leur collaboration?**

ANNEXE A

Statistiques choisies sur l'activité scientifique et technologique du Canada

Pourcentage du PIB consacré par certains pays de l'OCDE à la R-D



1) à l'exception de tout ou partie des SNG

Dépenses brutes de R-D en pourcentage du PIB

	Dépenses de l'État	Dépenses de l'industrie
Canada	0,64	0,48
Australie	0,78	0,22
Autriche	0,51	0,58
Finlande	0,56	0,63
France	1,07	0,82
Allemagne	1,04	1,42
Italie	0,48	0,51
Japon	0,64	1,48
Pays-Bas	0,89	0,87
Norvège	0,73	0,51
Suède	0,89	1,28
Suisse	0,55	1,72
Royaume-Uni	1,21	1,02
États-Unis	1,24	1,23

* Source: OECD Selected S&T Indicators. Les pourcentages sont ceux de 1981, sauf pour la Suisse (1979)

Scientifiques et ingénieurs (SNG+SH) oeuvrant en R-D dans certains pays de l'OCDE, par 10 000 membres de la population active.

Pays	1971	1973	1975	1977	1979	1981
Scientifiques et ingénieurs			(nombre total)			
États-Unis	527 100	518 400	532 700	570 300	621 000	691 400
Japon	247 309	292 097	316 860	331 467	366 998	392 625
Allemagne	90 206	101 019	103 736	110 972	121 978	128 162
France	60 100	62 700	65 300	67 981	72 889	85 500
Canada	-	21 734	22 960	24 900	26 300	29 670
Pays-Bas	14 192	14 247	15 460	17 368	18 270	19 436
Suède	-	12 362	14 759	-	11 760	15 235
Suisse	8 541	9 854	10 568	11 835	10 720	
Population active			(milliers de travailleurs)			
États-Unis	87 198	91 756	95 955	101 142	107 050	110 315
Japon	51 860	53 260	53 230	54 520	55 960	57 070
Allemagne	26 910	26 985	26 397	26 074	26 449	27 376
France	21 638	22 083	22 310	22 697	23 059	23 271
Canada	8 727	8 358	10 059	10 578	11 287	11 978
Pays-Bas	4 793	4 802	4 862	4 877	4 948	5 593
Suède	3 961	3 977	4 129	4 174	4 268	4 332
Suisse	3 167	3 203	3 027	2 935	2 972	3 060
Scientifiques et ingénieurs			(nombre par 10 000 membres de la population active)			
États-Unis	60,4	56,5	55,5	56,4	58,0	62,0
Japon	47,7	54,8	59,5	60,8	65,6	69,0
Allemengne	33,5	37,4	39,2	42,6	46,1	47,0
France	27,8	28,4	29,3	30,0	31,6	37,0
Canada		23,2	22,8	23,5	23,3	25,0
Pays-Bas	29,6	29,7	31,8	35,6	36,9	36,0
Suède		31,1	35,7	-	-	35,0
Suisse	27,0	30,8	34,9	40,3	36,1	-

Sources: "Science and Technology Indicators. Basic Statistics Series, Volume C, Total R&D Personnel", OECD DSTI/(92. 59, Paris, 1982.
Statistical Yearbook, UNESCO, Paris, 1981 "Labour Force Statistics 1962-1982, OECD, Paris, 1983, p.19.

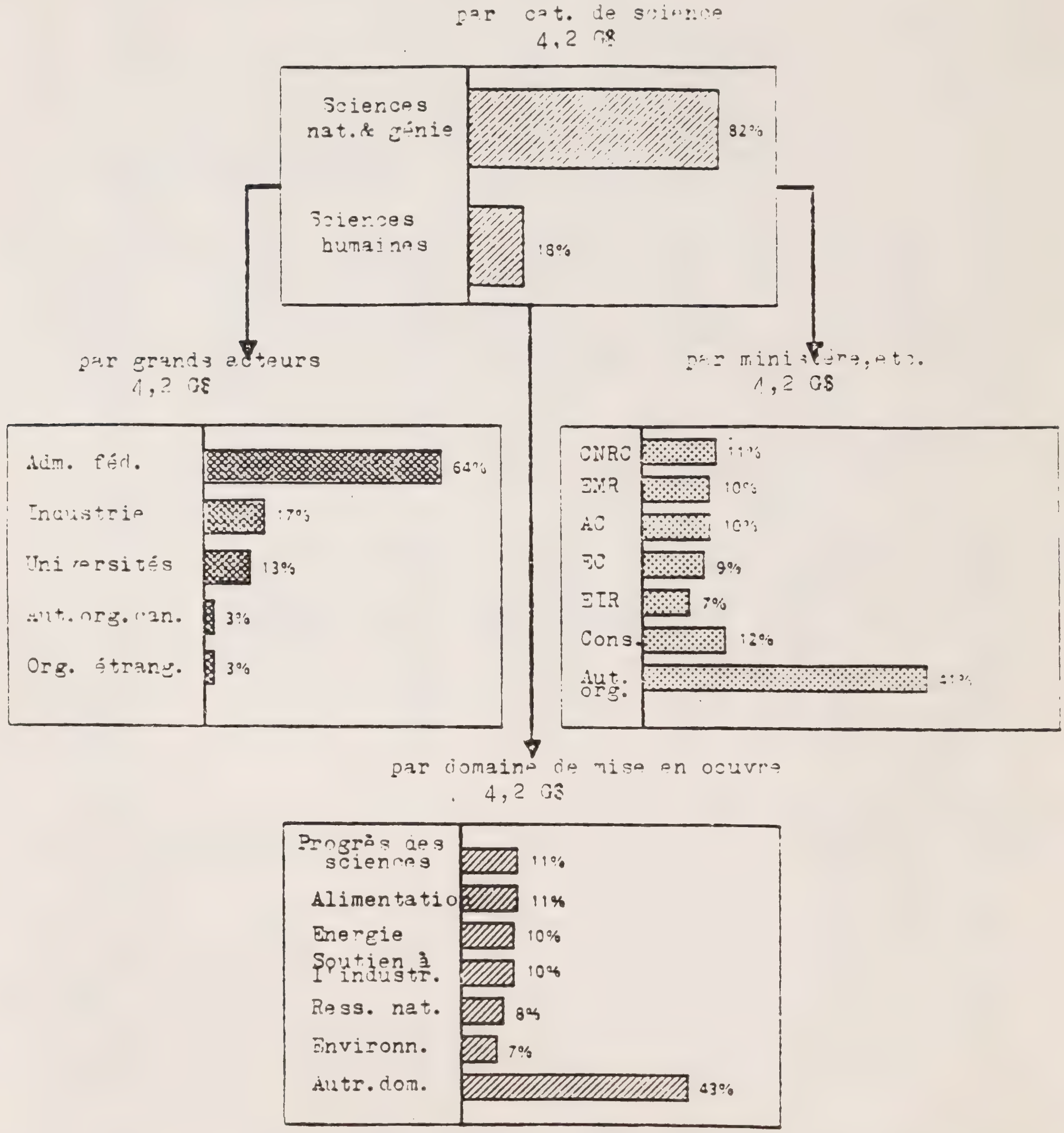
Dépenses de R-D du Canada en 1985

Sciences naturelles, génie et sciences humaines
(en M$)

Secteurs de financement	Secteurs d'exécution					Total
	Adm. féd.	Adm. prov.	Entreprises	Universités	Autres organ.*	
Administrations:						
fédérale	1 480	–	303	460	29	2 272 (35,8%)
provinciales	–	165	39	169	68	441 (6,9%)
Total	1 480	165	342	629	97	2 713 (42,7%)
Entreprises	–	–	2 446	34	18	2 713 (39,3%)
Universités	–	–	–	701	–	701 (11 0%)
Organismes privés sans but lucratif	–	–	–	133	36	169 (2,7%)
Organismes étrangers	–	–	256	13	–	269 (4,2%)
Total	1 480 (23,3%)	165 (2,6%)	3 044 (47,9%)	1 509 (23,8%)	152 (2,4%)	6 350 (100,0%)

* Autres organismes: organismes privés sans but lucratif (75 M$) et organismes provinciaux de recherche (77 M$)

Répartition des dépenses fédérales en sciences et technologie pour 1985-1986

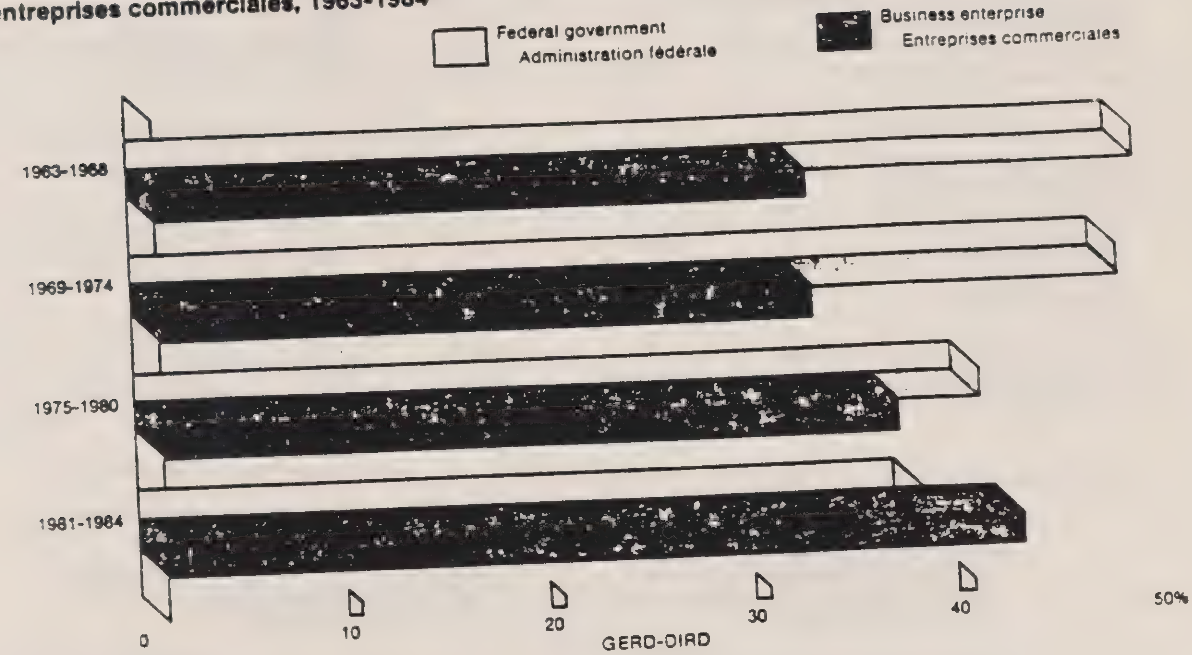


1) CNRC Conseil national de recherches du Canada
EMR Min. de l'Énergie, des Mines et des Ressources
AC Agriculture Canada
EC Environnement Canada
EIR Min. de l'Expansion industrielle régionale
Cons. Conseils subventionnaires (de recherches médicales, de recherches en sciences naturelles et en génie, de recherches en sciences humaines)

Chart — 1.5

Federal and Business Enterprise Funding of R&D, 1963-1984

Financement de la R-D par l'administration fédérale et les entreprises commerciales, 1963-1984



Source: Appendix Table 2.
Source: Tableau 2 de l'annexe.

Dépenses fédérales en matière d'enseignement postsecondaire[1] : Recherche[2] (en millions de dollars)

	1982-83	1983-84	1984-85 *
Conseils subventionnaires[3]			
Conseil de recherches en sciences naturelles et en génie	210,8	238,7	260,6
Conseil de recherches médicales	106,5	113,9	127,5
Conseil de recherches en sciences humaines[4]	30,8	35,9	37,9
Total partiel, conseils subventionnaires	348,1	388,5	426,0
Autres ministères et organismes			
Conseil national de recherches	25,2	27,2	31,1
Santé et Bien-être social	8,4	8,9	14,5
Secrétariat d'État du Canada	0,0	0,2	9,1
Agriculture	5,9	6,0	7,8
Énergie, Mines et Ressources	6,7	9,0	7,6
Environnement	4,8	7,3	6,5
Défense nationale	5,0	5,9	5,4
Autres	13,2	11,6	15,2
Total partiel, autres ministères et organismes	69,0	76,0	97,1
Total général, dépenses de recherche	417,2	464,5	523,1

1 Source (à moins d'indication contraire) : Statistique Canada, Division de l'éducation, de la culture et du tourisme, enquête sur les dépenses fédérales en matière d'éducation, 1984-1985.

2 Englobe toutes les dépenses à l'exception a) des sommes versées à des particuliers et qui sont assimilées aux données de la catégorie de l'aide aux étudiants, et b) des dépenses administratives, qui sont assimilées aux autres dépenses de la catégorie de l'aide fédérale directe.

3 Les dépenses des conseils subventionnaires ont été réparties en trois catégories : aide à la recherche, aide aux étudiants et administration. Le tableau 8 ne rend compte que des dépenses engagées pour l'aide à la recherche.

4 Source (pour 1983-1984) : Statistique Canada, Division des statistiques des sciences et de la technologie, Dépenses du gouvernement fédéral pour des activités reliées aux sciences humaines, de 1970-1971 à 1985-1986.

Balance commerciale au titre des produits de haute technologie et autres produits ouvrés en 1980 et 1984
(en M$)

	1980	1984
Produits de pointe	-8 157	-11 974
Produits à technologie moyenne	-4 628	-6 114
Produits à faible technologie	-2 821	-4 453
Produits basés sur les ressources	13 243	15 262
Automobiles et pièces détachées	-2 661	2 994
Total	-5 024	-4 335

Source: Statistique Canada, Technology and Trade Statistics: Part I, juillet 1985.

Part canadienne du marché des produits à fort contenu en R-D en 1970 et 1983

(pourcentage du total des exportations de l'OCDE)

Équipement aéronautique et spatial	1970	5,9
	1983	3,5
Ordinateurs	1970	5,6
	1983	5,8
Matériel électronique	1970	1,9
	1983	1,8
Produits pharmaceutiques	1970	2,1
	1983	1,7
Appareillage scientifique	1970	3,1
	1983	2,0
Appareils électroniques	1970	1,7
	1983	1,2
Appareils non électriques	1970	10,6
	1983	10,5
Produits chimiques	1970	0,8
	1983	2,3

Source: OECD - Trade in High-Technology Products, DSTI/SPR/84.66, Janvier 1985

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DOCUMENT: 830-220/040

Developing and Acquiring New Knowledge

NATIONAL FORUM ON THE DEVELOPMENT OF A CANADIAN SCIENCE AND TECHNOLOGY POLICY

A Submission Prepared By

SASKATOON ADVANCED TECHNOLOGY MANAGEMENT COMMITTEE

June 8-10, 1986
Winnipeg, Manitoba

DEVELOPING AND ACQUIRING NEW KNOWLEDGE

1.0 University Research

Canada is not getting maximum benefits from money spent on university research. Steps which might be taken to improve the situation include:

Establishment of a "database" or "catalogue system" for all government funded - university based research programs. This would enable universities and industry to cross-reference their activities to prevent overlapping and redundency. This database or catalogue should be distributed nationally on an annual basis to private sector firms and universities.

If new money were to become available, a portion should be prioritized for projects which are carried out jointly with industry, i.e.) joint co-operation between industry and universities would be mandatory before government funding would be approved. The remaining portion should be used to increase existing industry research programs that are currently available to industry only.

The rate of progress between university-industry co-operation is not satisfactory for several reasons including among others: university/government bureaucracy which tends to protract industrial research initiatives which are time constrained relative to windows of market opportunity.

Also due to a perception on the part of industry that there is little incentive within university/government administrations to focus their activities to current, beneficial and marketable projects.

Solutions to these present situations could include discouraging university imposed maximum consulting rules and encourage more grass roots communication between universities and industry at all levels from corporate executives to research technicians and research engineers. Refinement of administrative and research funding guidelines would serve to allow a more timely response to industrial research priorities.

Industry should encourage greater cross-fertilization between universities and industrial research organizations. This cross-fertilization should allow the exchange of research personel, product developments, and market intelligence as to technological advances nationally and internationally.

...2

2.0 Government Laboratories

The benefit received by Saskatchewan Advanced Technology Industries from the approximate 1.6 billion dollar annual Federal Government Budget is minimal.

Monitoring, accessing, administering and implementing of research projects in association with government laboratories or under funding provided by such organizations, has for many companies, become little more than a "shell game", due to continual program changes and budget re-allocations. An associated fact is that most of Saskatchewan's advanced technology firms are in a embryotic stage with limited human and financial resources to sustain the investment required to effectively access current programs.

Improved access and responsiveness would allow industry to better utilize existing resources in pursuing corporate goals and objectives.

3.0 Putting Knowlege to Work and Realizing Opportunities

Targeting science and technology resources is best achieved through market forces, rather than deliberate planning by government, except in situations which require specific regional development incentives necessary to overcome economic disparity.

Rather than government attempting to lead industry by a definitive science and technology strategy, government resources would be better employed in fostering a growth in the proportion of Gross Domestic Product expended on research and development.

The benefits would be threefold: The improved economic performance with the associated multipliers; Canada could improve its position relative to other OECD countries (ie: Canada ranked 10th in 1982); and increase the potential for opportunities which are market based.

Apart from government incentive grants, venture capital can best be fostered and targeted to high risk advanced technology industries by the implementation of tax measures designed to spur the availability in Canada of venture capital.

...3

Similarly, because of the hesitation of the banking industry to recognize intangible assets of advanced technology companies, increased investment could be obtained through such instruments as loan guarantees, development bonds and other mechanisms aimed specifically at reducing the perceived risk faced by traditional lenders.

DOCUMENT: 830-220/041

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

Association canadienne-française pour l'avancement des sciences

le 8-10 juin 1986
Winnipeg (Manitoba)

VEUILLEZ NOTER

Association
canadienne-française
pour l'avancement
des sciences

acfas

Montréal, 4 juin 1986

Monsieur Frank Oberle
Ministre d'Etat
Science et Technologie
Ottawa, Ontario
K1A 1A1

Monsieur le Ministre,

J'assistais hier à Québec à la séance de discussions sur les politiques scientifiques et technologiques canadiennes convoquée par votre ministère. Je remplaçais à pied levé notre président, M. Gilles Paquet, retenu à une réunion de la Société Royale du Canada.

Je n'ai certes pas l'expérience des professionnels de la recherche invités. Qu'il me soit toutefois permis de contribuer au débat par les réflexions que m'a inspirées cette rencontre.

Quatre points soulevés par les participants m'ont particulièrement frappé:

1) <u>La nécessité de favoriser l'émergence de pépinières d'entreprises à haute teneur technologique (les spin off)</u>

Moyens:

a) En mettant à la disposition d'étudiants de 2e et 3e cycles, pour un temps variable selon le succès de leur entreprise, des bureaux d'affaires dans des universités (plus que quiconque, ces étudiants doivent faire face au marché).

b) En assortissant les clauses salariales universitaires de la nécessité de trouver des revenus d'appoint dans l'industrie, suivant une proportion qui tiendrait compte de la vocation du professeur (enseignant ou chercheur), et des règles d'éthique inhérentes aux formes de concurrence déloyale avec les consultants privés.

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.../

c) En subventionnant l'équivalent de la somme consentie par une entreprise pour permettre à un de ses chercheurs de se recycler à l'université. En faisant la même chose pour un professeur d'université qui voudrait se "ressourcer" dans une entreprise (si celle-ci veut de lui, évidemment!).

d) En accordant des bourses de 2e et 3e cycles à l'étranger assorties d'un engagement de "retour au pays" équivalent à la durée de la bourse.

2) <u>"L'activation" du capital apparemment disponible au Canada en vue de favoriser le transfert technologique</u>

Moyen:

Constituer au Canada une Agence de promotion technologique (à partir du personnel du CNRC ou du CRSNG, par exemple) dont le seul rôle serait de faire expertiser rapidement par le milieu scientifique et industriel des projets innovateurs. Les projets retenus seraient financés par le secteur privé, à condition que le gouvernement garantisse le rendement de l'investissement. Ce principe de levier a été récemment suggéré en matière de développement de la recherche pharmaceutique par le rapport Casey. Cela semble un moyen efficace d'être à la fois conservateur (en composant avec la sagesse des banques canadiennes) et progressiste (en assumant un certain risque).

3) <u>L'augmentation des effectifs de recherche dans les universités du Québec</u>

Moyens:

a) <u>L'engagement de professeurs à l'université</u>. L'une des façons économiques de réaliser cet objectif consisterait à ramener l'enseignement du premier cycle universitaire au Québec à quatre ans, comme c'est le cas dans le reste du Canada, en abolissant une des deux années du collège général (cegep) où les professeurs n'ont généralement pas la formation pour réaliser une recherche compétitive. Ceux qui possèdent les qualités requises pourraient être "recyclés" à l'université. Quoique dramatique sur le plan humain, cette solution apparaît économiquement souhaitable.

.../

b) L'engagement de personnel strictement affecté à la recherche. Il importe d'aller chercher des leaders qui sauront regrouper autour d'eux des gens compétents et habilités à "s'autofinancer" auprès du CRSNG, CRSH, CRM et de l'entreprise privée. Encore faut-il garder ces gens! Au Québec, une certaine homogénéité culturelle engendre une captivité relative de nos chercheurs, malgré la surtaxation individuelle. Dans le reste du Canada, les centres de recherche perdent systématiquement leurs meilleurs joueurs. Par ailleurs, le Québec a doublement de la difficulté à s'attirer des chercheurs de grand talent: double obstacle de la langue et de la taxation. Toute politique scientifique est donc sous-tendue par des politiques strictement fiscales: "Why pay more to have less?" (en anglais dans le texte). Le Québec pourrait s'en tirer en faisant miroiter l'aspect enrichissant d'une seconde langue pour les chercheurs étrangers et celui, plus substantiel, d'un abattement fiscal au moins équivalent à celui qu'on aurait à Houston ou à Boston.

c) La désyndicalisation du corps professoral (hypothèse à investiguer).

4) La "lubrification" des mécanismes de transfert technologique

Moyens:

a) Préciser le rôle respectif des universités et des entreprises dans le financement de la recherche. La bombe lancée à l'occasion de l'annonce du financement des trois organismes subventionnaires n'a pas explosé: personne ne sait à quoi s'attendre et l'impression se répand qu'une telle proposition masque un manque chronique de fonds gouvernementaux dont les universités feront demain les frais.

b) Contribuer à publiciser les entreprises canadiennes de pointe auprès des milieux industriels tant canadiens qu'étrangers. Utiliser au maximum le personnel des ambassades canadiennes pour faire connaître non seulement nos grandes entreprises mais aussi celles qui naissent.

c) Relancer les campagnes en faveur de l'achat de produits canadiens par les consommateurs canadiens (à partir d'arguments économiques). Toute entreprise de haute technologie devrait d'abord assurer son marché local avant de conquérir l'étranger. Encore faut-il un marché local!

On se demande par quel masochisme les scientifiques canadiens s'ostracisent eux-mêmes lorsqu'on constate que même les comités de pairs des organismes subventionnaires canadiens dévaluent systématiquement les contributions à des revues (ou même à des universités) canadiennes! Les industries canadiennes doivent croire qu'une technologie peut être à la fois canadienne et meilleure. C'est au chapitre très publicitaire de la fierté collective que le gouvernement peut agir.

En fin d'analyse, un leitmotiv en matière de politique scientifique m'apparaît plausible: ne pas nuire à ce qui marche!

Le gouvernement (les gouvernements) a (ont) un premier mandat d'efficacité dans les dépenses de fonds publics qui leur dicte d'investir dans les domaines les plus économiquement (et socialement) rentables. Ceux-ci ne sont pas toujours ceux qui sont les plus politiquement rentables, et c'est là une faiblesse de la démocratie. Nous sommes toutefois persuadés que tout investissement gouvernemental dans la recherche publique, para-publique ou privée restera populaire auprès de l'électorat encore pour quelques bonnes années. Autant en profiter ... puisque c'est profitable.

En vous remerciant de l'attention apportée à la présente, je vous prie d'agréer, Monsieur le Ministre, l'expression de mes sentiments distingués.

Le directeur général

Guy Arbour

GA/jt

N.B.: Les avis émis sont les miens et ne sauraient engager notre Conseil d'administration.

c.c.: M. François Ameye
M. Guy Bertrand
M. Yves Bérubé
M. Roger Blais
M. Bernard Bonin
M. Pierre Coulombe
M. J.A. Foritn
M. Michel Giroux
M. ANdré Lemay
M. Paul Major
M. Gilles Paquet

DOCUMENT: 830-220/042

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Current Research Programmes in Science and Technology

The Institute for Research on Public Policy

June 8-10, 1986
Winnipeg, Manitoba

THE INSTITUTE FOR RESEARCH ON PUBLIC POLICY

Current Research Programmes in Science and Technology

Several of the IRPP research programmes are investigating science and technology issues.

1. Canada's Trade in High-Tech Products: A Case Study of Business Equipment. A recent overview of this research project has received considerable media attention.

Many Canadians have expressed concern about Canada's deficit in high-tech products. This research project examines the classification procedures currently used in the calculation of high-tech trade, and it raises questions about the appropriateness of these procedures. The project also considers the causes and implications of the high-tech trade deficit. Should this deficit be a reason for concern? Should it lead Canadian governments to implement particular kinds of public policies?

The project studies the relationships between Canadian industrial strategy and high-tech trade. It examines the role of tariffs, programs of financial assistance, government procurement preferences, various regulatory policies, and the protection of intellectual property.

Current and anticipated trade negotiations will focus on these elements of industrial strategy. These programs and policies can alter free market price ratios, creating "unfair competition" for foreign corporations and

distorting trade patterns. For this reason, the industrial strategy literature and the free-trade literature may soon conflict in the arena of international trade negotiations.

This project is being conducted by Dr. David Conklin, France St-Hilaire, and Professor John Whalley. Questions and comments can be directed to them at the Department of Economics, Social Science Centre, University of Western Ontario, London, Canada N6A 5C2.

2. Canada's Trade in Services. IRPP is currently initiating a series of studies on various aspects of this subject. Many of these studies will deal with science and technology issues. In particular, individual case studies will examine computers, communication, financial services, business consulting and engineering, and transportation. Comments and questions can be directed to Dr. Rod Dobell, President, The Institute for Research on Public Policy, 3771 Haro Road, Victoria, British Columbia V8P 5C3.

3. Telecommunications and Information. For many years, IRPP has conducted research in this area. Most recently, it co-sponsored a conference, May 26-28, 1986, on the subject of The Role of Information in the Economy. Other co-sponsors were the U.S. National Commission on Libraries and Information Science, the British Library, the Faxon Company, and Dun and Bradstreet Corporation. Future conferences are being planned. In 1985, IRPP published the book Computer Communications and the Mass Market in Canada, by Barry Lesser and Louis Vagianos. Comments and questions should be directed to Professor Barry Lesser, The Institute for Research on Public Policy, P.O. Box 3670, South Halifax, Nova Scotia B3J 3K6.

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A REVIEW OF PROBLEMS AFFECTING R & D IN THE PUBLIC SERVICE

for

The National Science and Technology Policy Forum

Prepared by the Professional Institute of the Public Service of Canada

Winnipeg, Manitoba
June 1986

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The Professional Institute believes that the formulation of a national science and technology policy must be linked to a comprehensive R & D strategy. The efforts of government, industry and universities must be coordinated to improve the quality of Canadian life and our stature and competitiveness abroad. In developing this policy, the federal government must recognize the unique attributes and capacities of the Public Service as a viable setting for R & D.

This summary outlines government policies and practices which detract from the ability of federal laboratories to act as effective partners in building an enhanced Canadian R & D capacity. The recommendations presented herein are designed to restore an environment for intramural R & D where the experience and expertise of scientists can be most productively expressed in order to meet federal programme objectives.*

Intramural Research vs. Contracting Out

The government's "Make or Buy" policy, which requires that mission-oriented R & D should, whenever possible, be contracted-out rather than performed intramurally, has resulted in the inadequate provision of sufficient and stable financial support for Public Service science. The "Make or Buy" directive, coupled with successive fiscal restraints, has eroded the capacity of Public Service laboratories to meet program mandates.

While the intent of this policy was to promote R & D in private industry to increase Canada's competitiveness abroad, it has not secured the vigorous and widespread growth of R & D capacities as originally envisaged. The private sector in Canada continues to suffer from a weak R & D infrastructure and a fragmented science and technology base. Although cases can be identified where contracting out has nurtured successful R & D ventures, many firms lack the financial resources, equipment and facilities, as well as a "critical mass" of scientists

* See Professional Institute brief, A Future for R & D in the Public Service?, 1983

required to mount and sustain innovative programmes and specialized research. The government must recognize that Public Service laboratories represent a national resource of vital importance, strategically situated to accept many R & D challenges which cannot be addresssed as effectively by the private sector.

The current trend in federal R & D spending for programmes with direct commercial applications hampers vital intramural research projects which do not yield direct or immediate benefits to industry. A substantial portion of Public Service science is devoted to non-commercial programmes which serve and safeguard the broader public interest in areas such as health and safety, preservation of the environment and conservation of natural resources, to name but a few. "Make or Buy" policies have resulted in a significant reduction of funds allocated to intramural research in areas such as industrial pollution, off-shore fisheries conservation, and standards regulation, to free dollars for use in areas with more visible commercial benefits.

We believe that, in many cases, the Public Service is a superior setting for R & D, especially where projects require allocation of longer-term resources, demand a "critical mass" of highly-trained scientists, or integrate basic research, design, testing and development activities. In the Institute's opinion, the government should review and revise the "Make or Buy" directive, recognizing that R & D dollars spent in the private sector are <u>not</u> by definition more productive than those spent on intramural projects.

<u>Technology Transfer</u>

A basic objective of the Public Service scientific community is to exchange concepts and research findings with the private sector, and to facilitate the translation of research innovation from federal laboratories into productive applications in industry. We believe progress toward government-industry coope-

ration can be enhanced through a greater interchange of resources and personnel between government research stations and associated private research facilities.

An effective, healthy research climate demands creative career development activities and the opportunity to exchange ideas and discoveries with external peers. The continuing need to raise the general level of scientific expertise can be met through peer assessment, debate at scientific conferences and seminars, work exchanges and laboratory visits, etc. If intramural R & D is to remain vigorous and healthy, scientists must also have freedom to play a more active role in scientific committees and learned societies at the national and international level. Such forms of professional development and networking are not perquisites of employment, but rather constitute essential elements of every scientist's job.

While the government continues to express its commitment to effective technology transfer, stringent Public Service restrictions on professional development activities (seen by management as "discretionary" rather than "necessary") are seriously impeding this process. Financial support for professional development programmes must be expanded if scientists are to keep pace with their disciplines and communicate with external peers.

Research cooperation between the public and private sectors can be further enhanced through the establishment of a formal programme for national and international scientific work exchanges. Professional development committees composed of R & D professionals should be established, with a mandate to enhance research cooperation between sectors. A program of this type would support technology transfer policy objectives while providing valuable professional development opportunities for Public Service scientists.

Personnel/Science Management

Management's adherence to standardized procedures and its preoccupation with input-output efficiency in the delivery of services over a set time frame is out-of-step with the requirements of an effective R & D environment. Laboratories must be free to manage their day-to-day affairs with committed resources and clear operational plans. In the Institute's opinion, government should consult its scientists on important matters relating to science management.

The burden of administration workloads on R & D personnel and the decline in technical support staff undermine staff's capacity to achieve project objectives. An increasing proportion of worktime is channelled into administrative duties which results in scientists being removed from the laboratory bench for far too much of their time. Staffing restrictions have a further debilitating impact on productivity. The ratio of technicians to scientists in many departments has fallen drastically, leaving many scientists to perform technical duties themselves. This results in the scaling down, postponement or elimination of projects. The Professional Institute recommends that government seek to reduce the time scientists must devote to administrative tasks, and that the ratio of technicians to scientists be increased.

Mechanisms for forecasting research personnel requirements should be augmented. We urge that all departments establish R & D staffing committees comprising practicing scientists to make recommendations on new staffing requirements. These committees would be in an ideal position to address the problem of the aging of the scientific workforce. Te government must act now to recruit young scientists to the Public Service, so that they may work directly with soon-to-retire personnel, rather than delaying recruitment action until vacancies actually occur. The recruitment of young scientists with new and creative ideas, and fresh perspectives would help to generate a more dynamic, productive environment.

Scientific Equipment

The lack of scientific equipment and materials in Public Service laboratories sorely impedes research productivity and effectiveness. While some government laboratories have been able to purchase new equipment over the past three years, many others still lag far behind, struggling to meet programme objectives with obsolescent instruments and inadequate basic supplies.

A particularly counterproductive policy which contributes to this situation involves the withdrawal, in 1979, of tax-free and duty-free status for foreign equipment purchases for all federal laboratories, except the NRC and the National Museum. There can be little justification for applying duties to such goods when they are used directly in the interests of the taxpayers. The effect of this policy has been to cut the real purchasing power of R & D equipment dollars outside Canada. This is further aggravated by the devaluation of our currency relative to U.S. funds. The Institute recommends that the government restore to all federal laboratories tax-free and duty-free status for equipment purchases.

The administrative complexity of equipment purchasing procedures in the Public Service also contributes a source of frustration to R & D personnel. Minor equipment and supply acquisitions must be directed through Supply and Services Canada. This often lengthens the purchasing process while multiplying administrative costs. We urge that the government permit greater decentralization of scientific equipment and supply purchasing authority to federal laboratories, where competitive tendering through Supply and Services is not demonstrably necessary to ensure good value for monies spent.

Conclusion

The successful development and implementation of a national science and technology policy requires the establishment of a vigorous R & D effort balanced among both the government, the private sector and universities. The ill health of any one sector will necessarily reduce the creativity and effectiveness of the other two. If the federal laboratories are to act as full and resourceful partners in building an enhanced national R & D capacity, the critical problems impeding their effectiveness and productivity must be addressed by the government without further delay.

COMMENTS ON THE FUTURE OF
R & D IN THE PUBLIC SERVICE OF CANADA
FROM THE NRC RESEARCH OFFICER VIEWPOINT

June 1986

1. Developing and Acquiring New Knowledge

R & D necessarily consists of several complimentary activities, which fall under the category of basic, curiosity-driven research and engineering/applied research, the latter in support of industrial innovation and development, technical support of social objectives and the operation of national facilities. Both basic and engineering/applied research must be maintained as viable intramural activities in the Public Service.

As a rule, speculative, high-risk research is conducted over a five to fifteen-year planning horizon and is more appropriately carried out in a government R & D setting. While pure or basic research may show success in as few as one project in ten, with no guarantee of technological application or commercial spin-offs, it can be justified based on the need to establish a base of expertise for future technology and for the purpose of advancing knowledge. A fixed percentage of overall R & D funding must continue to be allocated to basic research. Responsiveness to the needs of industry must be balanced by a responsiveness to the reed to conduct basic research in the intramural R & D setting.

Collaboration and information exchanges between government, universities and industry ensures the dissemination of knowledge and the opportunity to capitalize on scientific and technological advances. Greater priority must be given to professional development activities, including work exchanges and increased contact with external peers. Such a commitment would demonstrate the government's belief in intramural R & D and in its desire to enhance technology transfer.

Applied research activities must be closely linked to both basic research groups and industry, thereby taking an idea and transforming it into a technology that can be used by industry to design a commercially viable product. Applied research requires larger project teams (presently consisting of one to three people) working with an identified customer (e.g. NRC, in fact, contracts in research from industry on a total or shared basis, with very economic results, for example, the gas turbine industry.)

The government R & D setting should be characterized by a greater mix of interrelated labs, applying a multi-disciplinary approach to problem-solving, which is so vital to success. A "critical mass" of scientific effort is needed, augmented by an increase in exchanges and collaboration between industry, universities and government.

Mission-oriented R & D projects should be responsive to market forces and the needs of industry, and the relevance of projects should be assessed by scientific advisory committees on an ongoing and ad hoc basis.

The monitoring of R & D contracting by the Department of Supply and Services at first seems to guarantee the lowest cost to projects. However, the practice of selecting the lowest bidder can result in low bidding for single-performer government contracts. This can occur in the middle of a development effort, resulting in a dilution of knowledge which may doom significant Canadian head starts to failure. This is particularly wasteful if development work is sequenced through several external organizations.

2. Putting Knowledge to Work and Realizing Opportunities

Technology transfer problems will require that government R & D experts assess the usefulness of projects in terms of commercial applications, and be accessible as a source of knowledge to colleagues in the private sector, to help trigger developments in new and emerging technologies. Public Service administrators or technical advisors will soon become irrelevant if they are not given the opportunity to conduct their own research.

The NRC's IRAP programme has established formal links with external clients, and ensures that public sector R & D is nurtured in high pay-off areas, in cost effective and time effective ways. If the government wants to obtain good value for money spent on research contracted out to the private sector, intramural researchers should be involved with these projects, initially and throughout the process.

Linkages must be established in the intramural R & D setting to enable applied researchers to identify and germinate basic research ideas, which have reached a point where an applied project can begin. This important transfer must not be hampered by internal bureaucratic procedures.

The current trend in the bureaucratization of laboratories should be resisted. NRC's responsiveness to external clients and its high productivity can be largely attributed to an "arm's length" relationship with management. Laboratories must be free to manage their daily business with committed resources and clear operational plans. Scientists should be able to conduct research and engineering projects while remaining integrally involved in a choice of professional directions.

3. Adapting to Change

External review procedures of intramural scientific programmes should be carried out on a regular basis, with an emphasis on cost effectiveness, the relative usefulness of programmes, comparisons with similar work in other countries and assessment of staff equipment and facilities. These reviews should, as a matter of completeness, include discussions with the scientists themselves.

Review Committees composed of experts from other countries examine entire divisional programmes at NRC every five years. These committees report their findings to NRC management, and divisional directors are required to submit follow-up action plans. NRC also has a system of Associate Committees, composed of experts in key technology areas, who advise NRC on fruitful or promising areas of investigation.

4. Putting a Strategy to Work

Critical areas of R & D that require ongoing federal involvement include:

- A "critical mass" of activity judged by industry as futuristic (five to fifteen year planning horizon) and high-risk research;

- Environmental and health issues ultimately carried out in the public interest;

- Standards development applicable to all sectors;

- Specialized projects and facilities requiring ongoing R & D;

- Technology demonstrations with potential for industrial applications.

The realities of a fragmented Canadian R & D infrastructure and the nature of our economy suggest that the public sector is the most appropriate forum to provide the lead role in transferring scientific knowledge. More aggressive methods of transferring this knowledge must be implemented, e.g. work exchanges and joint programmes between the public and private sectors.

The success of technology transfer has been clearly demonstrated in NRC's IRAP and PILP programmes, with practicing intramural scientists as key participants and consultants in the process. NRC's technical advisors also provide an ongoing link with the private sector, keeping industry up-to-date with new and ongoing NRC research programmes.

The public's perception of scientific and technical advances is marred by fear and distrust. R & D tends to receive little credit for its successes and wide publicity over its failures. An ongoing public relations effort is needed to educate the public and promote the benefits accrued by scientific and technological progress.

DOCUMENT: 830-220/044

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Statement tabled by the Honourable Tony Penikett, Government Leader, to the National Science and Technology Forum

Government of the Yukon

June 8-10, 1986
Winnipeg, Manitoba

THE YUKON IS PLEASED TO PARTICIPATE IN THIS FORUM AND TO HAVE THE OPPORTUNITY TO ADD OUR CONCERNS TO THE FORMULATION OF A NATIONAL POLICY ON SCIENCE AND TECHNOLOGY.

WE ARE PARTICULARLY ENCOURAGED THAT IN THE BACKGROUND PAPER FOR THIS CONFERENCE, THE MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGY RECOGNIZES AND HIGHLIGHTS THE NEED TO ENSURE THAT THE VARIOUS REGIONS OF CANADA SHARE THE BENEFITS OF SCIENCE AND TECHNOLOGY. TO DATE THE YUKON HAS BEEN LARGELY OVERLOOKED BY THE FEDERAL GOVERNMENT IN TERMS OF HELPING US TO DEVELOP OUR SCIENTIFIC SUPPORT CAPABILITIES AND INFRASTRUCTURE. THERE IS A VERY LARGE AND UNJUSTIFIABLE DISPARITY IN THIS RESPECT BETWEEN THE YUKON AND ANY SIMILAR JURISDICTION IN CANADA. IF A NATIONAL POLICY ON SCIENCE AND TECHNOLOGY CAN FOCUS ON SUCH REGIONAL DISPARITIES AND HELP TO FILL THESE GAPS IN OUR NATIONAL RESEARCH EFFORTS, IT WILL HAVE OUR FULL SUPPORT.

IN MANY WAYS, THE YUKON IS A STRIKING EXAMPLE OF ONE OF YOUR MAJOR CONCERNS - CANADA'S DEPENDENCE ON THE EXPORT OF RAW AND UNFINISHED PRODUCTS IN A CLIMATE OF EVER-INCREASING COMPETITION FROM COUNTRIES WITH LOWER PRODUCTION COSTS AND/OR HIGHER PRODUCTIVITY. AS YOU POINTED OUT, THE NEWLY-INDUSTRIALIZED COUNTRIES ARE THREATENING THE MARKET SHARE OF OUR TRADITIONAL RESOURCE-BASED INDUSTRIES AND AS A RESULT OUR RESOURCE SECTORS ARE SUFFERING.

FOR EXAMPLE, IN 1982, THE YUKON WITNESSED THE SHUTDOWN OF COPPER, LEAD, ZINC, AND SILVER MINES. AS A RESULT, MINING PRODUCTION FELL FROM A VALUE OF $360 MILLION IN 1980 TO $59 MILLION IN 1983, THE IMPACT ON THE YUKON ECONOMY WAS FAR WORSE THAN THESE NUMBERS SUGGEST BECAUSE A MULTIPLIER EFFECT SENT SHOCK WAVES THROUGH ALL OTHER SECTORS OF OUR ECONOMY.

THE VARIOUS BACKGROUND PAPERS TO THIS FORUM STRESS THE IMPORTANCE OF ENCOURAGING THE TRANSFER AND APPLICATION OF TECHNOLOGY WITHIN EXISTING INDUSTRIES, PARTICULARLY THE PRIMARY RESOURCE SECTOR. WE SUPPORT THIS CONCEPT WHOLEHEARTEDLY. UNFORTUNATELY WE CANNOT YET TAKE AN ACTIVE PART IN THIS PROCESS BECAUSE WE LACK THE NECESSARY SCIENTIFIC SUPPORT FACILITIES OR INFRASTRUCTURE. WE WOULD LIKE TO SEE THIS FORUM DEVELOP A NATIONAL SCIENCE POLICY THAT WOULD HELP TO BRING THE YUKON INTO THE MAINSTREAM OF THE SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENTS OF THE MORE ADVANCED REGIONS OF THIS COUNTRY.

TO THAT END, THE YUKON HAS TAKEN A NUMBER OF INITIATIVES TO FACILITATE THAT PROCESS. FOR EXAMPLE, RECENTLY, MY GOVERNMENT ACCEPTED A YUKON SCIENCE POLICY AND WE HAVE TAKEN STEPS TO CREATE A SCIENCE PRESENCE WITHIN THE TERRITORIAL GOVERNMENT. WE ARE HERE BECAUSE WE RECOGNIZE THE GLOBAL IMPORTANCE OF SCIENCE, RESEARCH, AND TECHNOLOGY AS BEING AMONG THE PRIME MOVERS OF ECONOMIC REVIVAL AND GROWTH. IN THE YUKON, WE ARE JUST BEGINNING TO EXPLORE THE VAST POSSIBILITIES FOR USING SCIENCE AND TECHNOLOGY AS TOOLS FOR FOSTERING OUR SOCIO-ECONOMIC DEVELOPMENT, AND AS SUCH, OUR GOALS AND PRIORITIES ARE CONSIDERABLY MORE FUNDAMENTAL THAN THOSE OF THE SCIENTIFICALLY MORE ADVANCED REGIONS OF CANADA. AT THIS STAGE OF OUR S&T DEVELOPMENT ONE OF OUR TOP PRIORITIES IS THE ESTABLISHMENT OF A SCIENTIFIC RESOURCE CENTRE IN THE YUKON THAT WILL, AMONG OTHER THINGS:

A) SERVE AS THE FOCAL POINT FOR THE TRANSFER AND ADAPTATION OF NATIONAL AND INTERNATIONAL DEVELOPMENTS IN SCIENCE AND TECHNOLOGY;

B) SERVE AS OUR LINK TO THE CANADIAN SCIENTIFIC COMMUNITY AND INTEGRATE THE YUKON INTO THE VASE DATA AND INFORMATION NETWORKS THAT ARE SO READILY AVAILABLE TO SOUTHERN CANADA;

c) ATTRACT AND PROMOTE SCIENCE PROGRAMS THAT CAN CREATE NEW EDUCATIONAL OPPORTUNITIES AND INCENTIVES FOR YUKON STUDENTS; AND,

D) ATTRACT THE SCIENTIFIC PROJECTS AND PERSONNEL, PROGRAMS, AND RESEARCH FUNDS THAT WE NEED TO HELP US FURTHER OUR SOCIO-ECONOMIC DEVELOPMENT.

OBVIOUSLY, OUR IMMEDIATE GOALS ARE CLEARLY COMPATIBLE WITH THOSE OF THE PROPOSED NATIONAL POLICY ON SCIENCE AND TECHNOLOGY. WE FEEL THAT A FORMAL ACCEPTANCE OF A NATIONAL POLICY CAN ONLY HELP OUR EFFORTS TO INTEGRATE THE YUKON INTO THE MAINSTREAM OF SCIENCE AND TECHNOLOGY IN CANADA AND AS SUCH IT HAS OUR FULL SUPPORT. WE REMAIN CONFIDENT THAT THE SPIRIT OF COOPERATION THAT HAS PREVAILED AT THIS IMPORTANT CONFERENCE WILL CONTINUE. WE SINCERELY HOPE, FOR YUKON'S SAKE AND FOR CANADA'S, THAT THE RESULTS WILL INCLUDE A TANGIBLE STRENGTHENING AND BROADENING OF THIS COUNTRY'S SCIENTIFIC AND TECHNOLOGICAL CAPABILITIES.

THANK YOU.

DOCUMENT: 830-220/045

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Yukon Science Policy

Government of Yukon

June 8-10, 1986
Winnipeg, Manitoba

Foreword

The need for a Yukon Science Policy arose from this government's recognition of the global importance of science, research and technology as the prime movers of economic revival and socio-economic development. It has been estimated that as much as two-thirds of the recent economic growth in Canada has been attributed to technological change and there is every reason to believe that its influence will grow.

A Science Policy is a fundamental first step towards developing our indigenous scientific and technological capabilities and integrating these into the mainstream of the research activities of the national and international scientific communities.

Our Science Policy is a clear signal to the federal science organizations, the granting agencies, and the universities that we are preparing to take a more active role in determining the nature and scope of science in the Yukon. The goals of the policy include the eventual establishment of a "science presence" and infrastructure within the government to: a) attract the scientific projects and personnel, programs, and funds to help further the Yukon's socio-economic development; b) attract and promote science programs that can create new educational opportunities and incentives for Yukon students; and, c) strive for the establishment of a Yukon-based scientific resource centre, essentially independent from government and industry, that is capable of conducting sound research on northern issues as defined by northerners and their institutions.

We are in the very early stages of developing a strategy on how best to employ science and technology as tools of the economic engine. Our resource-based industries need innovative methods to reduce costs and to increase productivity if we are to maintain or increase our share of the market.

The development of new technically advanced industries must be encouraged wherever these match the natural advantages of the Yukon. For example, new methods of locating, processing and refining metal ores could revitalize marginal operations. Innovations in the chemical and bio-technological leaching of precious metals could radically change the face of our metal industry; and, recently, startling advances have been made in controlling the fertility and reproduction of fur-bearing animals in captivity. We need a Yukon-based science capability because it is important to know what others are doing and to judge whether their advances can be usefully applied at home.

The publication of a Yukon science policy will demonstrate to the Canadian science community that we have formulated clear and specific goals and objectives for the role of science and technology in territorial affairs. It will show that the Yukon is taking positive steps towards becoming a serious contender for the available research funds and scientific support services. It will serve notice that we are preparing the groundwork for the devolution of federal science programs and the associated regulatory functions of federal science departments.

A statement of policy in itself is only the beginning of our efforts to ensure that science and technological adaptation become components of our long term social and economic strategy. On the basis of this policy, specific actions will be taken to help us reap the benefits that science and technology can provide. Through the development of such activities and programs the Yukon will be able to look forward to the future with the confidence that it is capable of taking advantage of the limitless opportunities science and technology offer.

Tony Penikett

YUKON SCIENCE POLICY

Basic Principles

A Yukon Policy, like all other public policies, is based on the three basic objectives of society in general: a) cultural enrichment, b) economic growth, and c) public welfare.

a) The advancement of scientific knowledge can play an increasingly important role in moving towards the goal of cultural enrichment. It is often said that basic research is a purely curiosity driven activity that has no practical purpose. Granted, a practical mission is not the primary objective of fundamental research but it does have a clear and definite purpose - scientific discovery and the advancement of knowledge. And that makes it an essential element of our cultural life and civilization.

b) Society's other interests in research and development center around the two broad categories of the innovation process. The first of these is aimed at the market place and is more related to economic growth. It is the natural result of industrial research and development.

c) The second category of innovation is aimed at solving broad social problems such as health, crime, poverty, poor education, and pollution. Thus, innovation in the social sciences for the public welfare constitutes another major goal of research and development and therefore of science policy.

With these broad social goals in mind, we can make some general statements on the guiding principles for a Yukon Science Policy. The overall science policy goal for Yukon is the creation and development of an independent research organization and infrastructure that can:

1. Identify research gaps and opportunities; plan and manage the resulting scientific activities and programs; and, evaluate the results.

2. Encourage scientific activity and research that will effectively contribute to: a) the protection and enhancement of Yukon's superb and spectacular environment; b) the attainment of balanced develoment; and, c) the enhancement of the quality of life in the Yukon.

3. Create and maintain an intellectual environment that will attract, promote, and support scientists and academics from home and abroad.

4. Lead to the development of an indigenous scientific community.

Additional overall tasks of a Yukon Science Policy are:

1. To maintain an integrated network for scientific and technological information on what is happening in the Yukon and elsewhere;

2. To ensure that the Yukon scientific establishment is adequate relative to national and international developments in science and technology;

3. To provide a balanced supply of scientific manpower and facilities relative to Territorial requirements;

4. To ensure a proper balance between scientific disciplines; between pure research, mission-oriented research, and development work; between government, industry, and the universities as performers of research;

5. To prevent over-expansion in certain areas of research and development and to identify and fill significant gaps in others; and

6. To ensure co-ordination in the overlapping needs of government departments where multi-disciplinary and inter-departmental programs are essential.

Some Specific Objectives

The following statements of objectives are meant to provide direction to Government of Yukon science activities and programs in pursuing the overall policy goals and tasks as described above.

1. Strive for the establishment of a Yukon-based scientific resource centre, independent from the federal government and industry, and capable of conducting sound research on Northern issues as defined by Yukoners and their institutions. The creation and development of independent research facilities together with close links to other northern and polar research institutes is the key to the development of a capable Yukon-based science community.

2. Give priority to the active recruitment and training of interested Yukoners with the objective of supporting the establishment and maintenance of a strong Yukon-based science community. We should develop incentives and provide stable educational opportunities for students to train in and enter professinal careers in science.

3. Ensure that government research programs and activities lead to levels of industrial and resource development that are ecologically sustainable, environmentally safe, socially acceptable, and economically sound. If balanced development is to be achieved, our science programs must keep pace with industrial activity. A much greater effort is needed in basic research on northern ecosystems and the socio-economic and environmental effects of industrial activity.

Research, intelligence, and monitoring programs are also needed by both government and industry to allow timely responses to unforseen impacts and developments.

4. Ensure the timely availability of science-based information for development and the accompanying environmental regulatory process. There is a need for an information centre to serve as a repository and clearing house of scientific information and to quickly and efficiently disseminate the results of research to the public.

   It is important that Yukoners have ready access to public information produced by the scientific community. Well-informed citizens and groups are a key element of the successful implementation of many public policies and programs. This can be done through original research, the establishment and maintenance of long-term data bases, through data acquisition links with Southern information networks, and the establishment of a Yukon-based scientific reference centre. Supporting conferences, symposia, seminars, workshops, and lectures are other excellent means of information dissemination. Encouraging organizers to convene such meetings in the Yukon can have additional benefits.

5. Increase the level of research to improve baseline data and the understanding of natural ecosystems, thus leading to a more effective management of our renewable resources and more balanced development. There is a need to establish and operate long-term research sites in relatively undisturbed areas of Yukon for uninterrupted monitoring of natural and man-made changes.

   The government's scientific data bases are frequently based on short-term impact studies, and there are not enough qualified scientific personnel within its ranks to interpret industry's research methods and conclusions. Too often, industry's data bases and interpretations are the only information available for government decision-making. The effectiveness of government planning (whether in the regulatory process, land-use, or development) is vitally dependent on ready access to unbiased and up-to-date information.

6. There are issues in science which require federal, provincial, territorial, or international cooperation and action. The most notable of these are the ones concerning river sytems and fresh-water resources, migratory species, the marine environment, and air quality. It is particularly important that we cooperate with our Canadian and circumpolar neighbours in the development and exchange of scientific information needed to manage these emerging issues.

7. Ensure that government research programs and activities contribute effectively to the protection and enhancement of Yukon's spectacular and unspoiled environment. The welfare of every human being is vitally linked to the quality of the natural environment, making this a very important and complex issue. The issues surrounding man-environment relationships and government response to them are particularly relavant in the Yukon. Here the relationships between environmental realities and human activities and welfare are very

direct. As environmental quality deteriorates so do the social, physical, psychological, and economic indices of society's well-being. Northern ecosystems are particularly vulnerable and there is little leeway for error.

8. Increase the level of research in the social sciences to promote social innovation and to enable Yukoners to improve their welfare and the quality of their lives.

   The Canadian North has a social environment that is often classified as a frontier, a place with a less entrenched social establishment, where social mobility is easier to achieve, and where rapid socio-economic changes create significant upheavals in the social order.

   The unacceptably high rates of suicide, homicide, accidents, alcoholism, abuse, and unemployment among northerners are all indicative of a highly stressed society. The traditional modes of adaptation are clearly no longer adequate and the newly emerging modes are but poorly understood.

   These problems have reached epidemic proportions in the North. There is an urgent need for fundamental research in the social sciences to uncover the roots of these problems and, more importantly, to find acceptable solutions.

9. We need a cooperative research strategy involving all sectors of the research establishment operating in the Territory. The fragmentary and independent approach of past projects will, of necessity, be replaced by more coordinated research efforts. Effective coordination can prevent duplication, increase efficiency, and facilitate exchanges and transfers of data and information between government, industry, and academic organizations and scientists. The successful solution of an ever increasing proportion of research problems is dependent on a multidisciplinary or interdisciplinary approach, making the role of coordination that much more important.

10. There has been insufficient emphasis on the role of economics in interdisciplinary research regarding energy and mineral development, renewable resources, and transportation systems. It is difficult to apply conventional theories of economic development to Northern situations because little is known of the unique problems of developing vast, remote, and sparsely settled regions. The natural environment is harsh and precarious, and physical access is limited by environment, technology and cost.

    There is a need for a careful re-examination of our development experiences with past "boom and bust" projects. Objective cost-benefit analysis are needed to clarify the real costs of these projects to society. We should weigh the immediate and obvious benefits of resource development (employment, increased economic activity, etc.) against the ultimate costs to society (social upheavals, pollution, environmental damage, etc).

We must also find means of evaluating the economic worth of Yukon's wildlife, spectacular scenery, and superb recreational opportunities. The final net worth of these amenities may be many times greater than the short-term benefits of resource development. Economic research and analysis are needed to clarify the relative and long-term merits of investing in resource development versus banking on Yukon's recreational and tourism potential. Standard economic analyses are not applicable to measuring the true value of these amenities. More interdisciplinary research is needed to develop new techniques for evaluating their worth to society in the real terms acceptable to policy makers, planners, and developers.

11. Strive to ensure, whenever possible and/or practical, that government research programs and scientific activities support and complement the science programs provided by the Territorial school system. We should endeavour to provide the educational opportunities and incentives to encourage careers and provide the manpower needed to Northern science and engineering.

Some of the ideas and concepts found in this document have been used in other places, at other times, and for different purposes. We respectfully acknowledge our indebtedness to the public servants and scientists who have shown us the way. While we cannot claim total originality, we readily accept the challenge of implementing these ideas under our unique Northern conditions and circumstances. A Yukon Science Policy is a first step towards creating and developing a science presence and infrastructure in the Territory.

To that end, all of our options are open. We can learn from the mistakes of the scientifically more advanced regions of Canada, and we have the enviable opportunity of doing things right.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

JUNE 8-10, 1986

WINNIPEG, MANITOBA

Developing and Acquiring New Knowledge

A1 and A2 Workshop

Developing and Acquiring New Knowledge

(Group A1)

In attempting to synthesise the many issues into a set of common themes, we examined the propostions arising from the briefs submitted to the Forum under three headings: Human Resources, Research and Development, and the University-Industry Interface. What follows is a summary of the positions espoused by the workshops.

A. Strong Support for Development of Human Resources

Proposition 4: "In conjunction with post secondary institutions, use should be made of all major research centres such as government laboratories and private sector facilities in the training of highly qualified human resources".

There was strong agreement in principle with this proposition. Nevertheless concerns raised included both matching demands for specialized manpower and retraining. And yet the group understood that in preparing for the future means preparing qualified people now to both conduct S&T and R&D, and to be wise and literate managers and decision makers in an S&T based culture. Canadians do not yet realize that S&T is already a natural part of our culture.

B. Research and Development in Canada

Proposition 1: "Given our industrial structure, the best way to produce the highly qualified human resources we need, and to assure a continuing flow of first class ideas, is, over and above the

augmentation provided by the matching program in the last budget, to increase substantially the level of support for research in Canadian universities".

Strong agreement, but the group still felt the case could be more strongly made if levels of support were established and a source of funding identified.

One person suggested total educational support at all levels was adequate, but that reallocation is required to reflect priorities that emphasise the increasingly strategic role of post-secondary education.

Sources of new funds ranged from:

a) further suggestions to increase tuition fees, but equally strong views to decrease or keep fees low were heard;

b) to reallocation of priorities at both Federal and Provincial levels to result in an increase in funds, and

c) finally, to "spending smarter" suggestions on existing programs.

This then raises the question of who decides priorities and criteria.

Proposition 2: Strong support for 2, in the version below:

"Support to the university for basic research and for research in designated strategic areas should be increased".

The major concern again was who decides what is strategic? That is difficult to get any consensus on, but what people did agree upon was that:

a) we must be more selective in supporting first-class people

b) we must support up-and-coming well qualified young faculty

c) Canada can not afford to dabble, and

d) cross-fertilisation of disciplines is to be actively promoted.

Proposition 5: Old Proposition thrown out. The following attracted strong consensus.

"It is urgent that there be a Federal-Provincial agreement on the respective responsibilities of governments for the funding of university-based research (direct and indirect costs)".

In two sessions, some participants strongly expressed the view that the proposition be expanded to call for complete renegotiation of the established program financing (EPF) agreements. Clearly this is a hot issue.

Proposition 3: In the original version, proposition 3 was rejected, either as a result of widespread disagreement or puzzlement as to what was being discussed.

In the following version of proposition 3 (one sentence added) consensus began to emerge, but the puzzlement on the issues still led to a substantial abstention on the part of many of the participants.

"Centres of research excellence should be promoted but not at the expense of <u>severe</u> maldistribution of research support among the provinces. But it makes no sense to do research and development anywhere that is not first class and innovative".

Comments included:

a) you cannot sustain a national team without a good farm system

b) good centres must be launched on existing strength, not built in vacuum. In some instances, networks of people can be established to meet needs of critical mass, rather than a physical centre. In many cases, centres of expertise in given specialization, matched to industry's needs, were felt more appropriate for certain regions of the country.

Proposition 7: "Where appropriate, the federal and provincial governments should meet on the subject of government laboratories with the intent of moving basic research to universities and possibly other institutions".

Proposition received much discussion and no consensus.

Clearly this question on the movement of basic research from government labs into university or industry milieu needs much more analysis and clarification of the real issues involved. However, if there were to be movement, people and funds must accompany the transition.

Highlights of discussion:

a) In those cases where provincial governments do not do basic research, 7 is redundant.

b) Advantages of Government Labs include national coverage and long term perspective.

c) Disadvantages include no training in R&D or renewal for staff.

d) Labour representatives objected to any move of research responsibilities out of the public sector, for reasons of social responsibility.

e) Much discussion focussed on what legitimate role government R&D should play in the future.

C. <u>University-Industry Interface</u>

Proposition 6: "Canada requires sector or technology oriented research centres which are aimed at industrial needs and priorities and which are supported by industry on a shared cost and collaborative basis with universities and governments. Such centres should act as brokers to acquire and diffuse both Canadian and foreign advanced technologies".

Definite support for Proposition 6, with the following concerns:

a) Some such centres already exist, therefore #6 should refer to building on such existing activity.

b) Most participants agreed that a test of viability is the willingness of industry to invest.

c) Others were concerned that we already have a plethora of such centres. More should be created only in response to definite needs.

d) A number of participants felt the centres should not act as brokers.

e) Labour representatives requested public representation on the Boards of such research centres.

f) Successful university-industry collaborations go to the heart of generating new wealth in Canada and promote multidisciplinary research.

Proposition 8: "To facilitate exchange of information and transfer of technology, it would be helpful to have a regular inventory of research and its outputs in Canada".

No disagreement but not excitement either.

Proposition 9: "Big ticket projects in basic science in Canada should be undertaken in conjunction with other countries".

Agreement, but little time for real debate throughout the day.

In conclusion, let us have courage and determination as Canadians to do what is important, and to surmount the barriers with wisdom and ingenuity! Where there is political will, there is a way.

Group A2

Developing and Acquiring New Knowledge

The three A2 groups reached a broad consensus on all the key issues. There was division over detail. Minority views were often vigorously presented. There was rarely a clear split in opinion along sectoral lines.

Debate centred on three themes:

1. Financial Support (Propositions 1,2,5)

Increased funding is needed for basic research. There is solid evidence to support this view and an increase is essential to assure more, high quality research and to support an adequate supply of trained personnel. Inflation protection should be restored to the granting Councils and the federal government should reconsider the Councils' 5-year plans. The proposed matching funding program is unrealistic. Governments must accept their prime responsibility to fund basic research which is essentially long-term and contrasts with industry's short-term needs. More applied (industrial oriented) research is needed but can only be developed within an overall improvement in research funding. Adequate funding would of itself encourage excellence, promote critical mass and should ensure a necessary long-term commitment to research.

The Established Programs Financing (EPF) is crucial in the funding package. Federal and provincial agreement is necessary to resolve the use of EPF in any national S&T strategy. A small minority opposed this view.

In general it was felt that improved research funding should be within the context of a national mission.

2. Labour and Training (Propositions 3,4)

Although the need for excellence in research was accepted, the concept of research centers must be qualified. In particular it was felt that excellence is based on people, not buildings and that adequate funding will generate excellence. Excellence can not be determined by government fiat. Excellence in research need not be restricted to universities but could be found in community colleges, government labs, and in industrial research centres. Excellence need not require a specific geographical focus in these days of rapid, effective communications.

Canada has too small pool of S&T expertise to restrict development to post-secondary institutions. Full use must be made for all facilities for research and training whether in government laboratories, industry or elsewhere. Equally, training is not restricted to graduate programs but starts at school level and is conditional on a broad public awareness of the importance of S&T. The labour movement, industrialists and academics all have a responsibility to promote

effective training programs. Nor should the social sciences or the humanities be neglected in the training of S&T personnel. Good management and communications' skills are all important for a national S&T policy.

3. Inter-Sectoral Cooperation (Propositions 6,7,8)

Inter-sectoral cooperation is essential to implement a national strategy. Industrially oriented research centres fill a valuable niche but should generally be established in response to the demands of industry and backed by private sector funding. However, in some cases governments should take a leadership role, particularly where there is an infant industry that cannot support the necessary expense to develop its own technological base. Moreover, individual universities and companies should be encouraged to cooperate wherever possible to their mutual advantage.

Basic research in Canada is thin on the ground. It would not be strengthened by dismantling government labs. Many labs serve a vital industrial role (e.g. for agriculture), maintain specialized equipment no Canadian industry can afford, or serve specific national needs e.g. standards and environmental management. A review of government labs is required to assess their mandates. Where they are designed to meet industrial needs, industry should have a more direct say in their management. The labour movement may also have an important role to play.

Any new inventory of research is undesirable and would be an inneffectual use of government funds. Inter-action among the different sectors to assure a ready flow of informatin is better encouraged by other means e.g. university labs could have" open days" for industry. A greater interchange of personnel among institutions would encourage technology transfer, as would increased use of patent files and the wider dissemination of the annual research reports of the granting Councils.

Proposition 9

Canada should support good science. Scale is unimportant Canada should not make a commitment to big-ticket items conditional on shared funding from other countries.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE
SCIENTIFIQUE ET TECHNOLOGIQUE

Du 8 au 10 juin 1986

WINNIPEG (MANITOBA)

Le développement et l'acquisition de nouvelles connaissances

Atelier A1 et A2

<u>Le développement et l'acquisition de nouvelles connaissances</u>

<u>(Groupe A1)</u>

Dans le but de synthétiser les nombreuses questions en un ensemble de thèmes communs, nous avons examiné les propositions présentées dans les documents soumis à la conférence dans trois catégories: ressources humaines, recherche et développement, et les rapports entre l'université et l'industrie. Voici un résumé des opinions émises lors des ateliers.

A. <u>Grand appui au développement des ressources humaines</u>

Proposition 4: "On devrait utiliser, parallèlement aux établissements postsecondaires, les grands centres de recherche, tels que les laboratoires gouvernementaux et ceux du secteur privé pour assurer la formation d'une main-d'oeuvre hautement qualifiée.

Cette proposition a été fortement appuyée en principe. Cependant, on s'est préoccupé à la fois de la nécessité d'assortir la demande de main-d'oeuvre spécialisée et de recyclage. Pourtant, le groupe se rendait compte que pour préparer l'avenir, il faut préparer <u>maintenant</u> des personnes qualifiées qui peuvent à la fois s'occuper de S et T et de R et D, et devenir des gestionnaires et des décisionnaire sages et ayant les connaissances voulues dans une culture axée sur les S et T. Les Canadiens ne se rendent pas encore compte que les S et T font déjà partie intégrante de notre culture.

B. La recherche et le développement au Canada

Proposition 1: "Compte tenu de votre structure industrielle, la meilleure façon d'obtenir la main-d'oeuvre hautement qualifiée dont nous avons besoin et de générer un flot continu d'idées de premier ordre, c'est d'accroître substantiellement le niveau d'aide à la recherche dans les universités canadiennes, en sus de l'augmentation offerte par le programme d'appariement instauré dans le dernier budget fédéral.

Appui certain, mais le groupe estimait que les arguments seraient plus solides si l'on établissait des niveaux d'aide et si l'on déterminait une source de financement.

Une personne a mentionné qu'il convenait de fournir un appui total à l'éducation à tous les niveaux, mais il faut procéder à une réallocation pour tenir compte des sujets prioritaires qui soulignent le rôle stratégique de plus en plus important que joue l'éducation postsecondaire.

Nouvelles sources de financement:

a) nouvelles propositions relatives à une augmentation des frais de scolarité, mais on a entendu d'autes opinions tout aussi fortes en faveur de la diminution des frais de scolarité ou de leur maintien à un niveau peu élevé;

b) réallocation de l'ordre de priorité aux paliers fédéral et provincial, ce qui donnerait une augmentation des fonds, et

c) finalement, suggestion de dépenser les fonds de façon "plus intelligente" dans les programmes actuels.

Cela a donné lieu à la question de savoir qui établit l'ordre des priorités et les critères.

Proposition 2: Très fort appui à cette proposition, dans la version ci-dessous:

"On devrait accroître l'aide accordée aux universités au niveau de la recherche fondamentale et de la recherche dans des secteurs stratégiques".

Ici encore, on se demandait surtout qui décide ce qui est stratégique? Il est difficile d'obtenir un accord unanime sur ce point. On a cependant convenu de ce qui suit:

a) Il faut être plus sélectif lorsqu'on appuie des personnes d'élite.

b) Il faut aider les jeunes professeurs qualifiés qui peuvent aller loin.

c) Le Canada ne peut pas se permettre de rester en arrière.

d) Il faut activement encourager l'interraction entre disciplines.

Proposition 5: Rejet de l'ancienne proposition 5. Ce qui suit a obtenu un fort consensus.

"Il est urgent que les gouvernements fédéral et provinciaux s'accordent sur leurs responsabilité respectives en matière de financement de la recherche universitaire (frais directs et indirects)".

Lors de deux sessions, certains participants ont insisté pour que la proposition soit élargie pour qu'elle prévoie la renégociation complète des accords de financement des programmes établis. Il ne fait aucun doute que c'est là un sujet brûlant.

Proposition 3: La version originale de la proposition 3 a été rejetée, soit parce qu'il y avait un désaccord général ou parce qu'on ne savait pas de quoi on discutait.

La version suivante de la proposition 3 (on a ajouté une phrase) a suscité peu à peu l'accord général, mais bon nombre de participants ne se sont toujours pas prononcés parce qu'ils restaient perplexes.

"Il faudrait encourager l'excellence dans les centres de recherche sans que cela n'entraine une répartition exagérément inégale de l'aide à la recherche entre les provinces. Cependant, cela n'a pas de sens de procéder à des activités de recherche et de développement ailleurs que dans des centres de première classe et innovateurs".

Commentaires:

a) On ne peut conserver une bonne équipe nationale sans un bon réseau de formation.

b) Il faut bâtir de bons centres sur les points forts déjà en place, non dans le vide. Dans certains cas, on peut établir des réseaux de personnes pour répondre aux besoins de la masse critique, plutôt qu'un établissement matériel. Souvent, on estimait que des centres regroupant des experts dans certains domaines assortis aux besoins de l'industrie, convenaient mieux dans certaines régions du pays.

Proposition 7: "Selon le cas, les gouvernements fédéral et provinciaux devraient étudier la question des laboratoires gouvernementaux dans l'optique du transfert de la recherche fondamentale aux universités et peut-être à d'autres institutions".

Cette proposition a fait l'objet de nombreuses discussions, et l'on n'est pas arrivé à un consensus.

Il est évident que la question de déplacement de la recherche élémentaire des laboratoires gouvernementaux vers l'université ou l'industrie exige que l'on analyse et précise bien davantage les vrais problèmes en question. Cependant, si ce mouvement avait lieu, il devrait entraîner un déplacement connexe des gens et des fonds.

Points principaux des discussions:

a) Dans les cas où les gouvernements provinciaux ne s'occupent pas de recherche élémentaire, 7 est redondant.

b) Les avantages des laboratoires gouvernementaux comprennent une couverture à l'échelle nationale et une perspective à long terme.

c) Parmi les désavantages, il y a un manque de formation en R et D ou de renouvellement pour le personnel.

d) Les représentants des syndicats s'opposaient à ce que l'on enlève les responsabilités en matière de recherche des mains du secteur public, pour des raisons de responsabilité sociale.

e) Une grande partie des discussions fut axée sur le rôle légitime que le gouvernement devrait jouer à l'avenir en matière de R et D.

C. <u>Rapports entre l'université et l'industrie</u>

Proposition 6: "Le Canada doit se doter de centres de recherche spécialisés dans certains secteurs ou certaines technologies et axés sur les besoins et les priorités de l'industrie. Ces centres devraient donner lieu à une collaboration et à un partage des coûts entre l'industrie, les universités et les gouvernements et servir d'intermédiaires pour l'acquisition et la diffusion des technologies de pointe canadiennes et étrangères.

Appui certain à la proposition 6, avec les réserves suivantes:

a) Il existe déjà certains centres de ce genre; 6 devrait donc indiquer qu'il faut tirer parti de ces activités.

b) La plupart des participants ont convenu que la volonté de l'industrie d'investir constitue un test de viabilité.

c) D'autres s'inquiétaient de ce qu'il existe déjà une plethore de tels centres. Il ne faudrait en créer davantage qu'en fonction de besoins précis.

d) Un certain nombre de participants estimaient que les centres ne devraient pas servir d'intermédiaires.

e) Les représentants des syndicats ont demandé à être représentés aux conseils de direction de ces centres.

f) La collaboration réussie entre les universités et l'industrie est au centre d'une nouvelle prospérité au Canada et doit promouvoir la recherche multidisciplinaire.

Proposition 8: " Pour faciliter l'échange d'information et le transfert de technologies, on pourrait constituer un répertoire des recherches effectuées au Canada et des réalisations auxquelles ont donné lieu ces dernières".

Aucun désaccord mais pas beaucoup d'enthousiasme non plus.

Proposition 9: " Les projets impliquant des dépenses majeures en équipement dans le domaine des sciences fondamentales devraient être entrepris seulement en coopération avec l'étranger.

Accord, mais peu de temps consacré à un vrai débat pendant toute la journée.

Pour conclure, ayons le courage et la volonté, en tant que Canadiens, de faire ce qui est important, et de surmonter les obstacles avec sagesse et ingéniosité. Vouloir, c'est pouvoir, surtout en politique.

Groupe A2

Le développement et l'acquisition de nouvelles connaissances

Les trois groupes A2 se sont entendus de façon générale sur les questions principales. Les discussions achoppaient sur des détails. Le point de vue des minorités a été défendu avec vigueur. Les opinions n'étaient jamais clairement partagées en fonction des domaines d'activités.

Les discussions ont porté sur trois thèmes:

1. Appui financier (propositions 1,2 et 5)

La recherche fondamentale a besoin d'un financement accru. Cette affirmation s'appuie sur des preuves solides et il est essentiel d'accroître les crédits pour assurer une augmentation de la recherche de pointe et s'assurer de disposer d'une main-d'oeuvre qualifiée. Les conseils qui accordent les crédits devraient être à l'abri de l'inflation et le gouvernement fédéral devrait réétudier leurs plans quinquennaux. Le programme d'appariement proposé pour le financement n'est pas réaliste. Les gouvernements doivent assumer leur responsabilité quant au financement de la recherche fondamentale qui est essentiellement à long terme et qui ne correspond pas aux besoins à court terme de l'industrie. Il importe de faire davantage de recherche appliquée (axée sur l'industrie), mais pour ce faire, des crédits

supplémentaires sont nécessaires. Un niveau de financement adéquat devrait encourager l'excellence, promouvoir la masse critique et assurer un engagement à long terme nécessaire à la recherche.

Le programme de financement des programmes établis joue un rôle critique. Il importe d'arriver à une entente fédérale-provinciale pour résoudre les problèmes liés à ce programme de financement dans une stratégie nationale de S et T. Une faible minorité s'est opposée à cette vue.

En général, on s'entendait pour dire que le financement de la recherche doit faire partie intégrante d'une politique nationale.

2. Main-d'oeuvre et formation (proposition 3 et 4)

Bien qu'on reconnaisse l'importance de l'excellence dans la recherche, il importe de définir le concept des centres de recherche. Les participants estimaient que l'excellence dépend des ressources humaines et non des installations et qu'un niveau de financement adéquat assurerait cette excellence. Le gouvernement ne peut espérer atteindre l'excellence par des décrets. L'excellence dans la recherche ne doit pas être uniquement l'apanage des universités; on doit pouvoir la retrouver dans les collèges communautaires, les laboratoires gouvernementaux et les centres de recherche industrielle. Grâce aux moyens de communication rapides et efficaces qui existent de nos jours, l'excellence n'a pas besoin d'un siège géographique particulier.

Les ressources du Canada dans le domaine de la S et T sont trop restreintes pour qu'on limite le développement de la recherche aux maisons d'enseignement postsecondaire. Il faut utiliser toutes les installations de recherche et de formation disponibles, que ce soit dans les laboratoires gouvernementaux, dans l'industrie ou ailleurs. Ainsi, la formation n'est pas restreinte aux programmes d'études supérieures mais commence à la petite école et elle dépend d'une vaste sensibilisation du public à l'importance de la S et T. Il incombe aux syndicats, à l'industrie et aux maisons d'enseignement de promouvoir des programmes de formation efficaces. Il ne faut toutefois pas négliger les sciences sociales et humaines dans la formation de la main-d'oeuvre de S et T. De bonnes aptitudes en gestion et en communication sont importantes pour une politique nationale sur la S et T.

3. <u>Collaboration intersectorielle (proposition 6,7 et 8)</u>

Une collaboration intersectorielle est essentielle à la mise en oeuvre d'une stratégie nationale. Les centres de recherche axée sur l'industrie occupent une place importante mais ils ne devraient exister qu'en fonction des besoins de l'industrie et être financés par l'entreprise privée. Toutefois, le gouvernement devrait parfois jouer le rôle de chef de file, surtout lorsqu'une industrie nouvelle ne peut financièrement développer sa propre assise technologique. De plus, il faudrait encourager les universités et les entreprises à collaborer lorsque cela sert leurs besoins.

La recherche fondamentale n'est pas bien ancrée au Canada. Le démantèlement des laboratoires gouvernementaux ne la consolideront pas. De nombreux laboratoires jouent un rôle industriel vital (entre autres pour l'agriculture), disposent de matériel spécialisé qu'aucune industrie canadienne ne peut se payer, ou répondent à des besoins nationaux précis comme la gestion de l'environnement et les normes. Il importe d'étudier le mandat des laboratoires gouvernementaux. L'industrie devrait jouer un rôle plus prépondérant dans la gestion des laboratoires qui effectuent de la recherche industrielle. Le syndicat peut également jouer un rôle important.

Il n'est pas souhaitable de procéder à un nouvel inventaire de la recherche, cela constituerait un gaspillage de fonds gouvernementaux. On encourage plutôt la consultation intersectorielle pour assurer un flot continu de l'information; les laboratoires universitaires pourraient ainsi organiser des journées "porte-ouverte" à l'intention de l'industrie. Un échange accru de personnel entre les maisons d'enseignement favoriserait le transfert de technologie, tout comme une utilisation accrue des dossiers sur les brevets d'invention et une plus grande diffusion des rapports annuels sur la recherche des conseils chargés d'octroyer les fonds.

Proposition 9

Le Canada doit appuyer les sciences. L'échelle importe peu. Le Canada ne devrait pas s'engager dans des projets impliquant des dépenses majeures et nécessitant la collaboration financière d'autres pays.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

JUNE 8-10, 1986

WINNIPEG, MANITOBA

Putting Knowledge to Work and Realizing Opportunities

B1 and B2 Workshop

PLEASE NOTE

Putting Knowledge to Work & Creating Opportunities
(Group B1)

Introduction

The general conviction was that the discussion of the propositions, and decisions relating to them, must be cast in some kind of wider framework.

The framework suggestions related to:

- a strong need for a "game plan", described as a set of objectives, a set of missions, in order to create a sense of direction and to help alleviate scarce resources - within an acceptable socio-economic framework.
- an emphasis on stability of policy. R&D has an extended time base. In order to plan for and execute it, we must be able to count on policies remaining in force for a number of years.
- the impossibility of implementing science policy without a drastic shift in education and public awareness toward a science culture.
- a strong sense that science and technology needs a stronger mandate in Cabinet. A higher profile is required.

- an agreement that, in addition to new policies and programs, there was a strong need to improve the coherence and management of the existing system.

- the principal focus of an S&T policy should be on improving industrial competitiveness and building on existing strengths and market niches. Within this context, views on the propositions were as follows.

There was very strong consensus on five needs:

- to mobilize government procurement to promote technological and innovative capability in industry and to favour, in that process Canadian-owned companies and only those foreign controlled companies with strong world product mandates. Government should also be a partner with industry in a team approach to foreign markets.

- to encourage the formation and direction of more seed capital to small and medium-size enterprises. The great need is for patient, seed capital willing to stay with the enterprise to three to five years before expecting a return.

- the inadequacy of the present systems of grants and tax incentives. The existence of a system at all was challenged and there was very strong agreement that a much more radical revision was required then "fine tuning". Specifically was mentioned the new attitude of National Revenue as being extremely skeptical of R&D activity leading to negative interpretations. Also the Provincial taxing of R&D incentives was opposed. The definition of R&D needs to be widened. Generally, grants were not favoured in comparison to tax incentives. The "matching grants" policy was regarded with extreme skepticism. A major review is needed in this area, which was deemed to be critical.

- to encourage cooperative precompetitive R&D in a given sector. However, there was considerable debate on an acceptable model for the Canadian environment.

- federal policy should support provincial initiative consistent with overall national leadership. However, fragmentation and duplication of effort must be avoided.

There was measured support for;

- ongoing consultations with industrial sectors to review their strategic positions, with some reservation about any formal structuring of this activity. One view indeed was that the activity should be entirely voluntary and did not therefore require formal policy action. Another view stressed the need for a stronger role for industrial associations.

- the rationalization of federally and provincially funded technology centres. There is a strong feeling that these centers have been unduly proliferated for the wrong reasons. There is also a sense that there should be a continuous audit and review of their missions using advisory boards from industry and other sectors.

- the expansion of existing programs, such as CISTI to help SMEs and others acquire and development technoology. It was suggesteed that there was more need to draw universities and colleges into this process, and student exchange programs were cited as a frequently useful mechanism.

There was considerable controversy over one issue:

- The sufficiency of R&D, and the exhortation of Canadian industry to devote more resources to R&D presented a major problem. The level of industrial R&D performed was thought to be a structural issue arising out of the nature of the Canadian economy which will require more fundamental policy initiative. SMEs are not capable of an increase in R&D effort given obvious cash flow difficulties. It was suggested in fact that the current setting of this problem is not merely more R&D, but that of improving the overall climate for innovation.

Theme 2: Putting Knowledge to Work and Realizing Opportunities

(Group B2)

Proposition

1. There is insufficient industrial R&D in Canada in comparison with our industrial competitors. All industries in Canada should take a longer term view than hitherto and should devote a larger proportion of their own resources to R&D, technology and innovation, and should do so even at the expense of quarterly and annual earnings.

   Note that industry, in this context, must be broadened to include all enterprises including the service sector; computer software; agriculture, etc.

2. There should be ongoing consultations within and between industrial sectors to promote linkages and to review their strategic positions with particular emphasis on the importance of new technologies and research, especially in the face of the prospects of a freer trade environment.

3. The present system of grants and tax incentives in support of industrial R&D is both adequate and reasonably balanced. Only some fine tuning is required. However the definition of research must be broadened and must include, for example, market research as well as the social sciences. National Revenue's definition of R&D is too narrow. As we move toward a knowledge-based society a redefinition of R&D will be essential.

4. Federal and provincially funded technology centres should be rationalized based upon extensive review and evaluation. There should be close association with industrial needs, and close affiliation with educational facilities.

5. Government should encourage cooperative, pre-competitive R&D among companies in given sectors and when appropriate to do this in partnership with government itself. An appropriate catalytic funding approach with built-in incentives for all participants is esential.

6. Government procurement to promote technological and innovative capability in industry, universities and other educational institutions, should be greatly increased through the mobilization of civilian and defence technology procurement programs. Such programs plus memoranda of understanding should favour Canadian-owned companies and those foreign controlled firms having genuine world-product mandates. Note that some caution was advised on this point vis-a-vis the free trade talks.

7. Governments should expand existing successful programs such as those of NRC (Technical Information Service) and university and other post-secondary liaison offices that assist small and medium -sized enterprises and large businesses to acquire, apply, and develop

technology. Particular attention should be paid to enhancing the capability of provincial research organizations, community colleges, as well as universities, to meet the technology, management, training, and human resource needs of SMEs and large businesses.

8. It should be a major aspect of a federal science policy to act in support of provincial initiatives by placing a greater emphasis on technology development in federal/provincial agreements.

9. Government policies to encourage significantly the availability of venture capital dedicated to start up and pre-start up funding should be strengthened.

10. There is a need to develop support for an entrepreneurial culture in Canada.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

LE 8-10 JUIN 1986

WINNIPEG (MANITOBA)

Faire servir les connaissances et profiter des occasions

Atelier B1 et B2

Faire servir les connaissances et <u>susciter</u> des occasions
(Groupe B1)

Introduction

De l'avis général, l'étude des propositions et des décisions s'y rapportant doit se faire dans un cadre plus vaste.

Les propositions relatives à ce cadre portaient sur les points suivants :

- La nécessité absolue d'avoir un "plan de travail", qui comporterait une série d'objectifs et de missions afin de créer un sens de l'orientation et d'aider à épargner des ressources rares, dans un cadre socio-économique acceptable.
- L'accent sur la stabilité de la politique. Le secteur de la recherche et du développement a une longue période de référence. Pour pouvoir planifier et exécuter les activités dans ce domaine, nous devons pouvoir compter sur des politiques qui demeureront en vigueur pendant un certain nombre d'années.

- L'impossibilité de mettre en oeuvre une politique scientifique sans changer considérablement l'enseignement et la sensibilisation du public à l'égard d'une culture scientifique.
- Le sentiment profond que le mandat relatif aux sciences et à la technologie a besoin d'être raffermi au sein du Cabinet. Le secteur doit être mis en évidence.

- Outre l'adoption de nouvelles politiques et de nouveaux programmes, la nécessité absolue d'améliorer la cohérence et la gestion du sytème actuel.
- Une politique scientifique et technologique devrait être axée surtout sur l'amélioration de la compétitivité industrielle et sur la nécessité de miser sur les points forts actuels et sur les marchés déjà établis. Dans ce contexte, les opinions suivantes ont été exprimées relativement aux propositions.

Cinq besoins ont fait l'objet d'un appui presque unanime :

- Mobiliser l'approvisionnement gouvernemental de façon à promouvoir la technologie et l'innovation au sein de l'industrie et à favoriser, dans le cadre de ce processus, les sociétés appartenant à des intérêts canadiens et celles qui appartiennent à des intérêts étrangers mais qui ont des

mandats importants de production mondiale. En outre, le gouvernement devrait faire équipe avec l'industrie pour aborder les marchés étrangers.

- Encourager l'investissement de mises de fonds initiales dans les petites et moyennes entreprises. Il y a un besoin important de bailleurs de fonds prêts à attendre de trois à cinq ans avant que leur investissement ne rapporte.

- Améliorer les systèmes actuels de subventions et d'incitations fiscales. L'existence même d'un système est contestée et nombreux sont ceux qui ont préconisé une révision plus radicale qu'une simple mise au point. Plus particulièrement, la nouvelle attitude du ministère du Revenu a été qualifiée d'extrêmement sceptique en ce qui a trait aux activités de recherche et de développement, ce qui entraîne des interprétations négatives. En outre, des objections ont été formulées relativement à l'imposition par les provinces des encouragements accordés en matière de recherche et de développement. Il y aurait lieu d'élargir la définition des besoins en recherche et en développement. En règle générale, on préfère les incitations fiscales aux subventions. La politique des "subventions de contrepartie" est considérée avec beaucoup de scepticisme. On estime que ce secteur, qui est jugé très important, nécessite une révision en profondeur.

- Encourager les activités préconcurrentielles coopératives de recherche et de développement dans un secteur donné. Toutefois, la question d'un modèle acceptable pour le milieu canadien a fait l'objet de longs débats.

- Faire en sorte que la politique fédérale appuie les mesures provinciales, tout en conservant un leadership national dans l'ensemble. Toutefois, il y aurait lieu d'éviter la fragmentation et le chevauchement.

Les points suivants ont fait l'objet d'un appui mitigé :

- La poursuite de la consultation avec le secteur industriel afin d'examiner sa position stratégique, mais des réserves ont été exprimées quant à la structuration formelle de cette activité. On a fait valoir que cette activité devrait être entièrement volontaire et qu'elle n'avait donc pas besoin d'une politique officielle. On a également exprimé la nécessité de faire jouer un plus grand rôle aux associations industrielles.

- La rationalisation des centres de technologie subventionnés par le gouvernement fédéral et par les provinces. Plusieurs estiment que l'on a mis sur pied trop de ces centres, souvent pour les mauvaises raisons. Certains croient également que leur mission devrait être révisée régulièrement par des conseils consultatifs composés de représentants de l'industrie et d'autres secteurs.

- L'élargissement des programmes actuels, comme celui de l'ICIST, afin d'aider les PME et les autres entreprises à se perfectionner dans le secteur de la technologie. Selon certains, les universités et les collèges devraient participer à ce processus, et les programmes d'échanges d'étudiants ont été mentionnés comme un mécanisme souvent utile.

La question suivante a soulevé beaucoup de contreverses :

- Le volume de recherche et de développement et l'incitation de l'industrie canadienne pour que des ressources additionnelles soient consacrées à ce secteur constituent un problème important. On estime que le niveau de recherche et de développement dans le secteur industriel est une question structurelle découlant de la nature de l'économie canadienne

et qu'elle nécessitera une politique plus fondamentale. Les PME sont incapables d'accroître leurs activités dans ce secteur, faute de ressources suffisantes. En fait, on a fait valoir que le problème ne consiste pas seulement à accroître la recherche et le développement, mais plutôt à améliorer le climat global de l'innovation.

Theme 2 - Faire servir les connaissances et profiter des occasions

(Groupe B2)

Proposition

1. Le Canada n'effectue pas suffisamment de R et D industrielle comparativement à ses concurrents. Il faudrait que toutes les industries canadiennes sachent penser à plus long terme et consacrent une plus grande part de leurs ressources à la R et D, à la technologie et à l'innovation, même si cela se traduit par une baisse de leurs revenus trimestriels et annuels.

   Dans ce contexte, le terme "industrie" doit être pris dans son sens large et désigne toutes les entreprises, notamment le secteur des services, les logiciels informatiques, l'agriculture, etc.

2. Les secteurs industriels devraient mettre sur pied un processus permanent de consultation intrasectorielle et intersectorielle en vue de favoriser la création de liens et d'examiner leurs propres stratégies, en fonction surtout des nouvelles technologies et recherches, et spécialement en vue des conséquences d'une libéralisation des échanges.

3. Le système actuel de subventions et d'encouragements fiscaux à l'appui de la R et D industrielle est adéquat et bien équilibré. Quelques ajustements seulement sont nécessaires. Par contre, la définition de la recherche doit être élargie de manière à englober par exemple la recherche sur la mise en marché ainsi que les sciences sociales. La

définition que donne le ministère du Revenu à la recherche est beaucoup trop restreinte. Une redéfinition de la R et D s'imposera à mesure que notre société s'appuiera de plus en plus sur le savoir.

4. On devrait rationaliser les centres de technologie financés par les gouvernements fédéral et provinciaux, suite à un examen et à une évaluation approfondis. Ces centres devraient répondre directement aux besoins de l'entreprise privée et entretenir des liens étroits avec les établissements d'enseignement.

5. Le gouvernement devrait encourager la R et D pré-concurrentielle exécutée en collaboration par les entreprises d'un secteur donné en s'associant à elles lorsque cela sert les intérêts des deux parties. Une formule appropriée de financement de mise en route, comportant des mesures d'incitation pour tous les participants, doit être établie.

6. On devrait augmenter considérablement le niveau des achats gouvernementaux en vue d'améliorer la capacité technologique et innovatrice de l'industrie, des universités et autres maisons d'enseignement, et cela, en utilisant au maximum les programmes d'acquisition de technologies civiles et relatives à la défense. De tels programmes, assortis de protocoles d'entente, devraient favoriser d'une part les entreprises sous propriété canadienne et d'autre part, les seules compagnies sous propriété étrangère qui disposent de véritables droits exclusifs de diffusion mondiale d'un produit. Il convient de signaler qu'on a recommandé d'agir avec soin dans ce cas, compte tenu des négociations sur la libéralisation des échanges.

7. Les gouvernements devraient élargir les programmes qui fonctionnent bien tels que ceux du Conseil national de recherches (Service d'information technique) et des bureaux de liaison des universités et des maisons d'enseignement post-secondaire qui aident les petites et moyennes entreprises à acquérir, appliquer et développer la technologie. Il faudrait surtout faire en sorte que les organismes de recherche provinciaux, les colleges communautaires ainsi que les universités soient mieux en mesure de répondre aux besoins des PME et des grandes entreprises en matière de technologie, de gestion, de formation et de main-d'oeuvre.

8. L'appui aux initiatives provinciales devrait constituer un élément important de la politique scientifique fédérale; cet appui pourrait consister à accorder une plus grande importance au développement technologique dans les ententes fédérales-provinciales.

9. Il faut renforcer les politiques gouvernementales visant à encourager de façon sensible la formation de capital de risque pour le financement de mise en route et le financement préalable au lancement d'entreprises.

10. Il faut développer un esprit d'entreprise au Canada.

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NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

JUNE 8-10, 1986

WINNIPEG, MANITOBA

Involving All Canadians and Adapting to Change

C1 and C2 Workshop

Theme 3: Involving Canadians and Adapting to Change

(Group C1)

Propositions 1,2 and 3

In the three workshops, participants emphasized the need for anticipatory planning which would help to minimize the social and environmental impact of technological change, and avoid the remedial intervention which is needed once the damage is done. There was a weaker consensus on the need for cooperative implementation of technological change.

There was also agreement on the need for safety nets to minimize the human cost of technological change. There was, however, dissent on who should pay for them and on the mechanisms to implement them. In particular, industry representatives did not accept the need for legislation which would limit their ability to compete on international markets. On the other hand labour considered such protection as absolutely essential to the preservation of not just a basic level of income security for workers but of their human dignity as well.

Many comments were expressed on the negative tone of propositions 1 to 3, which many thought gave the impression that technology has only negative effects on employment. Many pointed out that technology can create jobs as well as eliminate them. Representatives from labour, however, insisted on the harsh reality of up to 50% unemployment in some regions of Canada.

Divergent views on development emerged. One claims that socioeconomic policies should be decided first and that technology should be subservient to social goals, especially those goals related to human dignity and decent standard of living. The other argues that the first priority is to encourage the development of technology in Canadian Industry in order to ensure that wealth be created in the future. Provided this is done, then in the process of doing it there is a need to give more attention to the impact on adversely affected elements of the society-retraining if possible, and a safety net if necessary.

Proposition 4

As a society, we must increase our knowledge base in order to study and report on the costs and benefits, as well as on the positive and negative impacts, of technological change. Existing programs of research should be expanded, interdisciplinarity encouraged, and researchers in the social sciences and the humanities should be invited to work together within flexible structures. Research in this field should look at technological change in a wider social context, and not just in the workplace.

Proposition 5

All participants agreed that a distinction should clearly be made between entrepreneurship and management. They had difficulty in believing that entrepreneurship can be imparted by formal training at university level, but

it certainly can be fostered by creating a more encouraging environment for it.

Participants suggested that the following strategies would help the emergence of entrepreneurship:

- cooperative education;
- work experience in industry; and
- some form of apprenticeship.

There was wide consensus on the usefulness and necessity of existing university level training programs in business management. These should include an appreciation of the role of science and technology in management.

Proposition 6

Provided there is a demand from students and the employment needs of industry can be addressed, then university level courses about the interactions between science, technology and society could be very valuable. Professionals in science and technology may well benefit from such courses as well.

Proposition 7

For Canada to cope with social changes, women and men need the best general education possible - an education comprising not only the traditional basics

of language and mathematics, but also the new basics of our contemporary culture: science, technology and their relationship to society. In particular, science education should be guaranteed in every elementary school.

Proposition 8

As science and technology are major parts of modern culture, Canada should have a broad variety of tools for communicating to the public the interactions between science, technology and society in their social and cultural context. This would include:

- more S&T museums/centres and more travelling exhibitions. The school system should make better use of existing museums/centres;
- a national magazine on science and technology issues, providing balanced views in lay terms;
- increased coverage of these interactions by television, radio and the media;
- the encouragement of voluntary organizations;
- an annual event such as Canada Science week.

Also, creative ways of financing these strategies must be found. Examples involving the private sector include:

- members of the Canadian Manufacturers Association involved in field trips, speakers, etc;

- Association des médecins canadiens de langue française: annual exhibition for the public and the schools on technological advances in medicine; and
- development of cooperative ventures between industry and the National Museum of Science and Technology.

Finally, academics should seriously attempt to make the public aware of their professional activities.

Proposition 9

Governments should recognize and state clearly that the advancement of knowledge (natural and social sciences, and the humanities) and technology are crucial to social and economic development. They should establish a mechanism where research, science and technology are represented at the highest level of cabinet decision-making.

Theme 3: Involving All Canadians and Adapting to Change
(Group C2)
A Digest of Propositions and Major Comments

Proposition 9

Comments

a) This proposition achieved a very rapid consensus in each of the three workshops, and was dealt with at the outset of every workshop discussion. It was suggested that cultural and social, as well as economic, development must be recognized.

b) It was pointed out that existing mechanisms should be fully utilized, such as the new House of Commons Standing Committee on Research, Science and Technology.

c) Some participants stressed the fact that because politicians are reacting to the electorate; we must address ourselves to the latter. However, most felt that this was too long a process, and a top down approach is needed.

d) Efforts must be accentuated to inform politicians of the pervasiveness of science and technology in society; many participants expressed the thought that legislators have virtually no feeling for science and technology, and tend to make policy decisions affecting S&T in a vacuum.

e) It was noted that while many provinces are reasonably well-equipped to deal with science and technology at the decision-making level, and are already involved in introducing these changes, the federal government is still not well-organized to deal with these issues. It was suggested that one Ministry or Department should be given sufficient powers and resources to help achieve the goals of a national science and technology policy.

Proposition 1

Comments:

a) The issue was judged to be very fundamental by many participants. However, the sources of wealth and how to achieve this (through what mechanism) were not made clear.

b) It should be recognized that the new technologies hold substantial promise for making work more interesting, and that the application of new technologies may also be expected to lead to new forms of employment, particularly in the service sector.

c) It should also be noted that not all industries are wealth-creating; many satisfying occupations are provided in the social services sector.

d) Many participants (not only labour) emphasized that technological change affects people, and this should remain a number one pre-occupation. In fact, several suggested that the three Themes be placed in priority, with Theme 3 as the first theme, and a pre-condition to the other two.

e) It was also noted that social policies should take cognizance of international shifts in industrial activity, and Canada should strive to obtain a larger share of the ownership benefits brought upon by technological change.

Proposition 2

Comments:

a) While agreeing with the thrust of this proposition, many participants felt that the statement should be put in a more positive light emphasizing the opportunities that arise from the problems (e.g. creation of an environmental industry).

b) Labour representatives were concerned that current labour displacements will not be sufficiently compensated by new employment in other sectors.

c) There was wide support amongst all sectors for the principle of co-operative planning and implementation of the necessary changes.

d) Flexibility is a cornerstone in assuring that our system can cope with technological change.

Proposition 3

New technologies will affect the quality and quantity of employment. The burden of change is being eased by paid educational leave, but major opportunities for re-training ought to be provided.

Comments:

a) This, of all propositions, was the most contentious, and was the subject of intense debate.

b) The opinions were strongly polarized, with labour representatives, (by and large) arguing for legislated rights for re-training and others expressing grave doubts about the efficacy of such a measure. In certain industries undergoing major structural changes, certain protective legislation may be required. However, a word of caution was raised noting that the hidden costs of contemplated legislation must be fully appraised.

c) Governments should also recognize that a lot of training in industry is going on (e.g. the AOSTRA model), but incentives may be required in certain sectors.

d) The problem of training and re-training also applies to universities and colleges, and these institutions have a major role to play. Nevertheless, people outside the educational system should not be overlooked.

Propositions 4 and 6

As a society, we have a responsibility to study and report on the root causes and impacts of technological change, particularly in so far as it effects the working population. Universities and colleges should be encouraged to pursue the study of these implications, involving the social and behavioural sciences, as well as the natural sciences and engineering. Furthermore, courses on science and technology and on their impact on society should be actively promoted. Increased new funding should be provided for this purpose, and existing programs should be more fully utilized.

Comments:

a) This proposition combines the original No. 4 and 6 as the responsibility to study these changes clearly does not lie solely with the behavioural and social sciences.

b) A major effort should be conducted in order to provide students in the humanities and the liberal arts with adequate courses on science and technology in society.

c) A major study on the future of work should be undertaken.

Proposition 5

Training in entrepreneurship and in the management of technology development and innovation is far from receiving sufficient attention. University faculties of engineering and business management, community

colleges and technical institutes must rectify this matter. In addition, institutes of higher education should establish short training programs in these areas for people already in the workforce. While not taking the lead, the business community should be involved in the planning and delivering of these programs.

Comments:

a) While doubt was expressed about the ability of educational institutions to create entrepreneurs, the need was recognized for passing on the acquired knowledge of entrepreneurs, and of fostering the motivation of individuals.

b) There was unanimous recognition of the importance of entrepreneurship in Canadian society, with emphasis on actively encouraging the entrepreneurial spirit in Canada.

c) Whereas in the past, the school system has been devoted to producing "employees", the challenge today is to help young people realize their ambitions and possibly create their own employment (e.g. student venture capital fund programs).

d) Entrepreneurship is particularly important for local, small-scale economic development initiatives.

Proposition 7

Comments:

a) This proposition we recognized as the fundamental condition that must be met if Canada is to meet the other propositions. Science education should be guaranteed at <u>all</u> levels of our school system.

b) Many participants made reference to the Science Council Science Education Study; and several noted the slowness with which provinces have reacted to the recommendations. Several also raised the issue of developing a veritable national educational policy that could overcome the jurisdictional balkanization that now exists in our present structure. Perhaps it is time for governments to consider a national conference on education.

c) Every effort should be made to encourage women to become interested in science and technology and choose careers in these fields.

d) Excellence in science education rests primarily on the quality of the teachers.

Proposition 8

Comments:

a) This proposition was readily accepted with the addition of a greater role for the visual arts and the media in public awareness.

b) Everyone recognized the importance of a greater degree of scientific literacy, and the achievement of a scientific culture.

c) Many fears concerning the new technologies can be overcome or alleviated by a better informed public.

d) Canadians must have faith in themselves; they must view themselves not merely as purchasers of foreign technologies, but as originators of indigenous innnovation. There is a need to build on Canadian achievements in science and technology.

e) Visible, technology-led major projects for changing public attitudes, and capturing the attention of society are needed (e.g. Canadarm).

f) Comments were raised concerning the role of ethnoscience; ie; knowledge from indigenous cultures must be recognized by governments, industry and the Canadian science community for its contribution to both the design of, and application of, new technologies.

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CONFERENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

Proposition (Thème 1, 2 et 3)

Conseil des sciences du Canada

du 8 au 10 juin 1986

Winnipeg, Manitoba

VEUILLEZ NOTER

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Thème I: Le Développement et l'Acquisition de nouvelles connaissances

Proposition

I. Compte tenu de notre structure industrielle, la meilleure façon d'obtenir la main-d'oeuvre hautement qualifiée dont nous avons besoin et de générer un flot continu d'idées de premier ordre, c'est d'accroître subtantiellement le niveau d'aide à la recherche dans les universités canadiennes, en sus de l'augmentation offerte par le programme d'appariement instauré dans le dernier budget fédéral.

2. On devrait accroître l'aide accordée aux universités au niveau de la recherche fondamentale et de la recherche dans des secteurs stratégiques.

3. Il faudrait encourager l'excellence dans les centres de recherche sans que cela n'entraîne une répartition exagérément inégale de l'aide à la recherche entre les provinces.

4. On devrait utiliser, parallèlement aux établissements postsecondaires, les grands centres de recherche, tels que les laboratoires gouvernementaux et ceux du secteur privé, pour assurer la formation d'une main-d'oeuvre hautement qualifiée.

5. Les gouvernements provinciaux devraient accorder plus de crédits à l'infrastructure et à l'appareillage de recherche universitaire, après quoi le gouvernement fédéral devrait accroître le financement nécessaire pour couvrir les coûts indirects de la recherche universitaire.

6. Le Canada doit se doter de centres de recherche spécialisés dans certains secteurs ou certaines technologies et axés sur les besoins et les priorités de l'industrie. Ces centres devraient donner lieu a une collaboration et à un partage des coûts entre l'industrie, les universités et les gouvernements et servir d'intermédiaires pour l'acquisition et la diffusion des technologies de pointe canadiennes et étrangères.

7. Selon le cas, les gouvernements fédéral et provinciaux devraient étudier la question des laboratoires gouvernementaux dans l'optique du transfert de la recherche fondamentale aux universités et peut-être à d'autres institutions.

8. Pour faciliter l'échange d'informations et le transfert de technologies, on pourrait constituer un répertoire des recherches effectuées au Canada et des réalisations auxquelles ont donné lieu ces dernières.

9. Les projets impliquant des dépenses majeures en équipement dans le domaine des sciences fondamentales devraient être entrepris seulement en coopération avec l'étranger.

Thème 2: Faire servir les connaissances et profiter des occasions

Proposition

I. Le Canada n'effectue pas suffisament de R et D industrielle, comparativement à ses concurrents. Il faudrait que l'industrie canadienne sache penser à plus long terme et consacre une plus grande part de ses ressources à la R et D, à la technologie et à l'innovation, même si cela signifie une baisse de ses revenus trimestriels et annuels.

2. Les secteurs industriels devraient mettre sur pied un processus permanent de consultation intrasectorielle en vue d'examiner leurs propres stratégies, en fonction surtout des nouvelles technologies et recherches, et spécialement en vue des conséquences d'une libéralisation des échanges bilatéraux.

3. Le système actuel de subventions et d'encouragements fiscaux à l'appui de la R et D industrielle est adéquat et bien équilibré. Quelques ajustements seulement sont nécessaires.

4. On devrait rationaliser les centres de technologie financés par les gouvernements fédéral et provinciaux, suite à un examen et à une évaluation approfondis. Ces centres devraient répondre directement aux besoins de l'entreprise privée et entretenir des liens étroits avec les établissements d'enseignement.

5. Le gouvernement devrait encourager la R et D pré-concurrentielle exécutée en collaboration par les entreprises d'un secteur donné en s'associant à elles et en leur accordant un financement initial équivalent au double du leur. Le gouvernement devrait nommer un coordonnateur expérimenté pour assurer la planification de chaque projet et en suivre le déroulement. Les travaux de recherche industrielle connexes effectués dans les laboratoires pourraient graduellement se placer sous l'autorité afférente à ces nouveaux projets.

6. On pourrait considérablement augmenter le niveau des achats gouvernementaux en vue d'améliorer la capacité technologique et innovatrice de l'industrie et cela, en utilisant au maximum les programmes d'acquisition de technologies civiles et relatives à la défense. De tels programmes, assortis de protocoles d'entente, devraient favoriser d'une part, les entreprises sous propriété canadienne et d'autre part, les seules compagnies sous propriété étrangère qui disposent de véritables droits exclusifs de diffusion mondiale d'un produit.

7. Les gouvernements devraient élargir les programmes qui fonctionnent bien tels que ceux du Conseil national de recherches (services d'information technique) et des bureaux de liaison des l'universités qui aident les petites et moyennes entreprises à acquérir, appliquer et développer la technologie. Il faudrait surtout faire en sorte que les organismes de recherche provinciaux, les collèges communautaires ainsi que les universités soient mieux en mesure de répondre aux besoins des PME et des grandes entreprises en matière de technologie, de gestion, de formation et de main-d'oeuvre.

8. L'appui aux initiatives provinciales devrait constituer un élément important de la politique scientifique fédérale; cet appui pourrait consister à accorder une plus grande importance au développement technologique dans les ententes fédérales-provinciales.

9. Il faut renforcer les politiques gouvernementales visant à encourager la formation de capital de risque et de pré-risque. Ainsi, une partie des fonds de pension provinciaux devrait être utilisée à cette fin plutôt que de servir a financer les déficits, comme cela se fait dans certaines provinces, et les profits réalisés sur les placements de capital de risque devraient être imposés aux mêmes taux que les gains en capital.

Thème 3: Faire participer tous les Canadiens et s'adapter au changement

Proposition

I. Les programmes économiques basés sur les progrès scientifiques et technologiques se heurteront à une résistance légitime si leurs coûts et leurs avantages sont perçus comme étant répartis injustement. Comme les industries créatrices de richesses augmenteront leur productivité et emploieront moins de travailleurs, des politiques sociales garantissant l'égalité des chances et la répartition équitable des revenus seront requises.

2. Pour beaucoup, la technologie élimine des emplois et menace l'environnement; les progrès technologiques devraient donc être mis en oeuvre, dans la mesure du possible, avec la participation, dès le début et de façon continue, de tous les groupes concernés. Ce processus de concertation pourrait être facilité par un amendement (a) aux lois sur le travail (en ce qui concerne la définition du progrès technologique; le préavis; la consultaion; et les normes de santé et de sécurité) et (b) aux lois sur l'environnement (en ce qui concerne la gestion des déchets toxiques, et le contrôle de la pollution).

3. Les nouvelles technologies auront une incidence sur la qualité du travail et sur le nombre d'emplois. Les congés d'éducation payés et l'instauration du droit légal au recyclage pourraient atténuer les problèmes causés par l'évolution technologique.

4. En tant que société, nous devons mettre au point de nouvelles techniques nous permettant d'évaluer les coûts et les avantages du progrès technologique et d'en rendre compte. Il faut donc accroître les fonds additionnels destinés aux spécialistes des sciences sociales et du comportement, et aux études sur les effets du changement technologique réalisées par des instituts de recherches spécialisées.

5. La formation en entrepreneurship et en gestion du développement technologique et de l'innovation n'existe à peu près pas. Les facultés universitaires de génie et de gestion, les collèges communautaires et les instituts techniques doivent combler cette lacune. De plus, les instituts d'enseignement supérieur, en collaboration avec les entreprises privées, devraient établir des programmes de formation de courte durée dans ces domaines à l'intention des personnes qui sont déjà sur le marché du travail.

6. Comme les décisions en matière scientifique et technologique ont une influence profonde sur les Canadiens, il est important que les cours sur les interactions entre sciences, technologie et société occupent une place importante dans les universités canadiennes.

7. Pour que les Canadiens puissent faire face aux changements sociaux, il faut qu'ils puissent bénéficier de la meilleure formation générale possible -- formation comprenant non seulement les matières de base traditionelles (langue maternelle et mathématiques), mais aussi les nouveaux aspects fondamentaux de notre culture contemporaine: Les sciences et la technologie et leurs rapports avec la société. Il faut surtout s'assurer que les sciences soient effectivement enseignées dans chaque école élémentaire.

8. Pour maintenir la stabilité sociale en période de changement rapide. Il faut que le public soit bien informé. Comme la science et la technologie sont des éléments importants de la culture moderne, le Canada devrait disposer d'un grand éventail de moyens pour renseigner la population sur les interactions qui existent entre la science, la technologie et la société. Il devrait donc notamment se doter de plus de musées ou de centres de sciences, posséder une revue nationale sur les questions scientifiques et encourager les organismes bénévoles existants.

9. Les gouvernements devraient reconnaître et déclarer que la science et la technologie sont d'importance cruciale pour le développement économique, et devraient mettre en place un mécanisme permettant d'intégrer la science et la technologie dans la prise de décision au plus haut niveau.

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CONFÉRENCE NATIONALE SUR LA POLITIQUE

SCIENTIFIQUE ET TECHNOLOGIQUE

DU 8 AU 10 JUIN 1986

WINNIPEG (MANITOBA)

Faire participer tous les Canadiens et s'adapter au changement

VEUILLEZ NOTER

Thème n° 3 : Faire participer tous les Canadiens et s'adapter au changement

(Groupe C1)

Propositions n°s 1, 2 et 3

Dans les trois ateliers, les participants ont souligné la nécessité d'une planification préliminaire qui aiderait à restreindre au minimum les répercussions sociales et environnementales du changement technologique et éviterait d'avoir à prendre les mesures de redressement qui s'imposent lorsque le dommage est déjà causé. La nécessité de la collaboration dans la mise en oeuvre du changement technologique n'a pas fait la même unanimité.

Tous ont également convenu de la nécessité de prendre des mesures de protection afin de réduire au minimum le coût du changement technologique sur le plan humain. Toutefois, il y a eu désaccord quant à savoir qui devrait payer pour ces mesures et quels devraient être les mécanismes pour les mettre en oeuvre. Plus particulièrement, les représentants de l'industrie estiment qu'il n'est pas nécessaire d'adopter des mesures législatives qui restreindraient leurs possibilités de soutenir la concurrence sur les marchés internationaux. Par contre, selon les syndicats,

cette protection est absolument nécessaire afin de préserver non seulement un niveau fondamental de sécurité du revenu pour les travailleurs, mais également leur dignité humaine.

Beaucoup d'observations ont été formulées relativement au ton négatif des propositions n^{os} 1 à 3 qui, selon plusieurs, donnent l'impression que la technologie n'a que des effets négatifs sur l'emploi. Beaucoup des participants ont signalé que la technologie peut créer des emplois et non seulement en abolir. Cependant, les représentants des syndicats ont insisté sur la dure réalité du taux de chômage, qui peut s'élever jusqu'à 50 p. 100 dans certaines régions du Canada.

La question du développement a fait l'objet d'opinions divergentes. Certains prétendent qu'il faudrait d'abord adopter des politiques socio-économiques et que la technologie devrait servir les objectifs sociaux, surtout ceux qui ont trait à la dignité humaine et à un niveau de vie convenable. D'autres estiment qu'il faut avant tout encourager le développement de la technologie dans l'industrie canadienne afin de pouvoir accumuler des richesses pour l'avenir. Le cas échéant, il y aurait lieu d'accorder plus d'attention aux répercussions négatives sur certains éléments de la société, par exemple, grâce au recyclage, si possible et à des mesures de protection, si nécessaire.

Proposition n° 4

En tant que société, nous devons accroître nos connaissances afin de pouvoir examiner les coûts et les avantages ainsi que les répercussions positives et négatives du changement technologique. Il y aurait lieu d'élargir les programmes de recherche actuels, d'encourager l'interdisciplinarité et d'inviter les chercheurs dans les domaines des sciences sociales et des lettres à collaborer dans le cadre de structures flexibles. La recherche dans ce domaine devrait considérer le changement technologique dans un contexte sociale plus large et non seulement en milieu de travail.

Proposition n° 5

Tous les participants ont convenu qu'il faut faire une nette distinction entre l'esprit d'entreprise et la gestion. Ils ont de la difficulté à croire que l'on puisse inculquer l'esprit d'entreprise à l'université, mais ils estiment qu'il y a certainement lieu de le favoriser en créant un milieu plus encourageant à cet égard.

Selon les participants, les stratégies suivantes aideraient à favoriser l'esprit d'entreprise :

- l'enseignement coopératif;
- l'expérience de travail au sein de l'industrie; et
- une forme d'apprentissage.

L'utilité et la nécessité des programmes universitaires actuels de formation en gestion des affaires sont largement reconnues. Ces programmes devraient comprendre une évaluation du rôle des sciences et de la technologie dans la gestion.

Proposition n° 6

Si la demande existe de la part des étudiants et si l'on peut répondre aux besoins des industries en matière d'emploi, il serait bon d'avoir des cours universitaires sur les interactions entre les sciences, la technologie et la société. Ces cours pourraient également être utiles pour les professionnels dans le secteur des sciences et de la technologie.

Proposition n° 7

Pour que le Canada puisse s'adapter aux changements sociaux, les hommes et les femmes doivent pouvoir bénéficier du meilleur enseignement possible, comprenant non seulement les matières traditionnelles de base de la langue et des mathématiques, mais également les nouvelles matières de base de notre culture

contemporaine, c'est-à-dire les sciences, la technologie et leurs rapports avec la société. Plus particulièrement, l'enseignement scientifique devrait être garanti dans chaque école élémentaire.

Proposition n° 8

Comme les sciences et la technologie constituent des éléments importants de notre culture moderne, le Canada devrait disposer d'une grande variété d'outils pour pouvoir communiquer à la population les interactions entre les sciences, la technologie et la société dans leur contexte social et culturel. Ces outils devraient comprendre, entre autres :

- des musées et des centres additionnels des sciences et de la technologie ainsi que des expositions itinérantes additionnelles. Le système scolaire devrait utiliser davantage les musées et les centres déjà en place;

- une revue nationale sur les sciences et la technologie, diffusant des opinions équilibrées en langage courant;

- un meilleur traitement de ces interactions par la télévision, la radio et les autres médias;

- l'encouragement des organismes bénévoles;

- une activité annuelle, comme la semaine canadienne des sciences.

Il y a lieu également de trouver des façons créatrices de financer ces stratégies. Voici quelques exemples de la participation du secteur privé :

- des membres de l'Association des manufacturiers canadiens effectuent des visites sur place, prononcent des allocutions, etc.

- l'Association des médecins canadiens de langue française (exposition annuelle pour le public et les écoles sur les progrès technologiques en médecine; et

- l'élaboration de mesures coopératives entre l'industrie et le Musée national des sciences et de la technologie.

Enfin, les universitaires devraient tenter sérieusement de faire connaître leurs activités professionnelles au public.

Proposition n° 9

Les gouvernements devraient reconnaître et formuler clairement le progrès des connaissances (en sciences naturelles et sociales ainsi qu'en lettres) et de la technologie qui sont essentiels au développement social et économique. Ils devraient mettre sur pied un mécanisme permettant de représenter la recherche, les sciences et la technologie au plus haut niveau du processus décisionnel du Cabinet.

Thème n° 3 : <u>Faire participer tous les Canadiens et s'adapter au changement</u>
(Groupe C2)
<u>Analyse des propositions et des principales observations</u>

<u>Proposition n° 9</u>

<u>Observations</u>

a) Cette proposition a rapidement fait l'objet d'un consensus au sein des trois ateliers qui ont entamé leurs discussions par l'étude de cette question. Selon certains, il y aurait lieu de faire mention du développement culturel et social en plus du développement économique.

b) On a signalé la nécessité d'utiliser pleinement les mécanismes déjà en place, comme le nouveau Comité permanent de la recherche, de la science et de la technologie de la Chambre des communnes.

c) Certains participants ont souligné le fait que, puisque les hommes politiques réagissent à l'électorat, c'est à celui-ci qu'il faudrait s'adresser. Toutefois, la plupart estiment que ce processus est trop long et qu'il faudrait adopter une démarche partant du sommet.

d) Il faudrait accentuer les efforts afin de renseigner les hommes politiques sur l'omniprésence des sciences et de la technologie dans la société. Selon de nombreux participants, les sciences et la technologie n'intéressent pas beaucoup les législateurs et ceux-ci ont tendance à prendre des décisions à l'aveuglette dans ce domaine.

e) On a fait remarquer que beaucoup de provinces sont assez bien pourvues pour traiter des questions de science et de technologie au niveau décisionnel et qu'elles ont déjà commencé à introduire ces changements, mais que le gouvernement fédéral n'est pas encore bien organisé dans ce domaine. On a proposé qu'un seul ministère soit investi des pouvoirs et des ressources nécessaires pour réaliser les objectifs d'une politique nationale des sciences et de la technologie.

Proposition n° 1

Observations

a) Beaucoup de participants estiment que cette question est très fondamentale. Toutefois, les sources de cette richesse et les mécanismes permettant d'atteindre cet objectif n'ont pas été précisés.

b) Il y aurait lieu de reconnaître que les nouvelles techniques offrent d'importantes possibilités de rendre le travail plus intéressant et que leur application peut également entraîner de nouvelles formules d'emploi, surtout dans le secteur des services.

c) Certains ont également signalé que les industries ne sont pas toutes productrices de richesses; le secteur des services sociaux offre également beaucoup d'emplois satisfaisants.

d) Beaucoup de participants (non seulement les syndicats) ont souligné que le changement technologique affecte les personnes et que cette préoccupation devrait prédominer. En fait, plusieurs ont proposé qu'un ordre de priorité soit donné aux trois thèmes, le troisième devenant le premier et un préalable aux deux autres.

e) On a également signalé que les politiques sociales devraient refléter les changements qui surviennent à l'échelle internationale dans les activités industrielles et que le Canada devrait tenter d'obtenir une plus large part des avantages découlant du changement technologique.

Proposition n° 2

Observations

a) Beaucoup de participants se sont dits d'accord avec l'idée générale de cette proposition, mais ils estiment qu'elle devrait être formulée d'une façon plus positive et souligner les possibilités qui découlent des problèmes (par exemple, la création d'une industrie de l'environnement).

b) Les représentants des syndicats craignent que les déplacements de la main-d'oeuvre ne soient pas suffisamment compensés par de nouveaux emplois dans d'autres secteurs.

c) Tous les secteurs ont fortement appuyé le principe de la planification et de la mise en oeuvre coopératives des changements nécessaires.

d) La flexibilité est la pierre angulaire qui permettra à notre système de s'adapter aux changements technologiques.

Proposition n° 3

La nouvelle technologie modifiera la qualité et la quantité de l'emploi. Le changement est facilité par des congés d'étude rémunérés, mais il y aurait lieu d'offrir d'autres possibilités de recyclage.

Observations

a) De toutes les propositions formulées, celle-ci a été la plus contestée et a soulevé de vives discussions.

b) Les opinions étaient fortement polarisées; les représentants des syndicats, dans l'ensemble, préconisant des droits au recyclage prévus dans les lois et d'autres exprimant des doutes sérieux quant à l'efficacité d'une telle mesure. Dans certaines industries subissant des changements structurels importants, il y aurait peut-être lieu d'adopter des mesures législatives protectrices. Toutefois, certains ont signalé qu'il faudra évaluer pleinement les frais cachés des mesures législatives envisagées.

c) Les gouvernements devraient également reconnaître que l'industrie fournit beaucoup de formation (par exemple le modèle du Bureau de recherche et de technologie des sables bitumineux de l'Alberta), mais que certains secteurs auront peut-être besoin de mesures d'incitation.

d) Le problème de la formation et du recyclage s'applique également aux universités et aux collèges, et ces établissements ont un rôle important à jouer. Cependant, il ne faudrait pas négliger les personnes à l'extérieur du système d'enseignement.

Propositions nos 4 et 6

En tant que société, nous avons la responsabilité d'étudier les causes fondamentales et les répercussions du changement technologique, surtout dans la mesure où il touche la main-d'oeuvre. Les universités et les collèges devraient être encouragés à poursuivre l'étude de ces répercussions dans les domaines tant des sciences sociales et des sciences du

comportement que des sciences naturelles et de l'ingénierie. En outre, il faudrait promouvoir les cours sur les sciences et la technogogie et leur impact sur la société. Des crédits additionnels devraient être accordés à cet égard et les programmes existants devraient être davantage utilisés.

Observations

a) Cette proposition regroupe les propositions 4 et 6 initales, car il est évident que la responsabilité d'étudier ces changements n'incombe pas seulement aux secteurs des sciences du comportement et des sciences sociales.

b) Des efforts devraient être déployés afin de fournir aux étudiants en lettres et en arts libéraux des cours adéquats sur les sciences et la technologie dans la société.

c) Il y aurait lieu d'entreprendre une étude importante sur l'avenir du travail.

Proposition n° 5

La formation en entreprenariat et en gestion du développement de la technologie et de l'innovation est loin de recevoir toute l'attention nécessaire. Les facultés d'ingénierie et de gestion des affaires, les collèges communautaires et les instituts techniques doivent corriger cette situation. En outre, les instituts d'études avancées doivent mettre sur pied des programmes de formation de courte durée dans ces domaines pour les personnes qui sont déjà sur le marché du travail. Le monde des affaires devraiT participer à la planification et à l'exécution de ces programmes, sans en prendre la direction.

Observations

a) Certains doutent que les établissements d'enseignement puissent créer des entrepreneurs, mais tous sont conscients de la nécessité de transmettre les connaissances des entrepreneurs et de favoriser la motivation des particuliers.

b) Tous s'entendent pour reconnaître l'importance de l'esprit d'entreprise dans la société canadienne et soulignent la nécessité d'encourager activement cet esprit au pays.

c) Dans le passé, le système scolaire s'est consacré à produire "des employés", mais le défi consiste aujourd'hui à aider les jeunes à réaliser leurs ambitions et peut-être à créer leur propre emploi (par exemple, par des programmes de capital de risque pour les étudiants).

d) L'esprit d'entreprise est particulièrement important pour les initiatives locales de développement économique de faible envergure.

Proposition n° 7

Observations

a) Cette proposition a été reconnue comme la condition fondamentale pour que le Canada puisse donner suite aux autres propositions. L'enseignement des sciences devrait être garanti à tous les niveaux de notre système scolaire.

b) Beaucoup de participants ont fait état de l'étude sur l'enseignement des sciences du Conseil des sciences et plusieurs ont signalé la lenteur avec laquelle les provinces donnent suite aux recommandations. Plusieurs ont également soulevé la question d'une véritable politique nationale de

l'enseignement qui permettrait de surmonter la balkanisation au sein de chaque administration qui existe dans notre système actuel. Il serait peut-être temps que les gouvernements envisagent la tenue d'une conférence nationale sur l'éducation.

c) Tous les efforts nécessaires devraient être déployés pour encourager les femmes à s'intéresser aux sciences et à la technologie et à choisir des carrières dans ces domaines.

d) L'excellence dans l'enseignement des sciences dépend avant tout de la qualité des enseignants.

Proposition n° 8

Observations

a) Cette proposition a été rapidement acceptée, mais on y a ajouté un rôle accru pour les arts visuels et les médias dans la sensibilisation du public.

b) Tous ont reconnu l'importance de l'accroissement des connaissances scientifiques et de l'acquisition d'une culture scientifique.

c) Une meilleure information du public permettrait d'alléger ou de dissiper de nombreuses craintes concernant les nouvelles techniques.

d) Les Canadiens doivent croire en eux-mêmes; ils doivent se considérer non seulement comme des acquéreurs des techniques étrangères, mais aussi comme les auteurs de mesures innovatrices. Il y aurait lieu de promouvoir les réalisations canadiennes en science et en technologie.

e) Nous avons besoin d'importants projets technologiques suscitant l'attention pour modifier les attitudes du public et capter l'attention de la population (par exemple, le bras spatial canadien).

f) Des observations ont été soulevées quant au rôle de l'etchno-connaissance, c'est-à-dire que les gouvernements, l'industrie et le monde scientifique canadien doivent reconnaître la contribution des cultures indigènes tant à la conception qu'à l'application des nouvelles techniques.

DOCUMENT: 830-220/049

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

Proposition (Theme 1,2 and 3)

Science Council of Canada

June 8-10, 1986
Winnipeg, Manitoba

Theme I: Developing and Acquiring New Knowledge

Proposition

I. Given our industrial structure, the best way to produce the highly qualified human resources we need, and to assure a continuing flow of first class ideas, is, over and above the augmentation provided by the matching program in the last budget, to increase substantially the level of support for research in Canadian universitites.

2. Support to the universities for basic research and for designated research in strategic areas should be increased.

3. Centres of research excellence should be promoted but not at the expense of severe maldistribution of research support among the provinces.

4. In conjunction with post secondary institutions, use should be made of all major research centres such as government laboratories and private sector facilities in the training of highly qualified human resources.

5. Provincial governments should increase funding for university research infrastructure and equipment whereupon the federal government should increase funding to cover indirect costs of university research.

6. Canada requires sector or technology oriented research centres which are aimed at industrial needs and priorities and which are supported by industry on a shared cost and collaborative basis with universities and governments. Such centres should act as brokers to acquire and diffuse both Canadian and foreign advanced technologies.

7. Where appropriate, the federal and provincial governments should meet on the subject of government laboratories with the intent of moving basic research to universities and possibly other institutions.

8. To facilitate exchange of information and transfer of technology, it would be helpful to have a regular inventory of research and its outputs in Canada.

9. Big ticket projects in basic science in Canada should only be undertaken in conjunction with other countries.

Theme 2: Putting Knowledge to Work and Realizing Opportunities

Proposition

I. There is insufficient industrial R&D in Canada in comparison with our industrial competitors. Canadian industry should take a longer term view than hitherto and should devote a larger proportion of its own resources to R&D, technology and innovation, and should do so even at the expense of quarterly and annual earnings.

2. There should be ongoing consultations within industrial sectors to review their strategic positions with particular emphasis on the importance of new technologies and research, especially in the face of the prospects of a freer trade environment.

3. The present system of grants and tax incentives in support of industrial R&D is both adequate and reasonably balanced. Only some fine tuning is required.

4. Federal and provincially funded technology centres should be rationalized based upon extensive review and evaluation. There should be close association with industrial need, and close affiliation with educational facilities.

5. Government should encourage cooperative, pre-competitive R&D among companies in a given sector to be undertaken in partnership with government and funded initially on a 2:1 government/industry basis. Government should appoint an experienced coordinator to help plan and monitor each project. Related industrial research in goverment could be gradually placed under the control of such new endeavours.

6. Government procurement to promote technological and innovative capability in industry should be greatly increased through the mobilization of civilian and defence technology procurement programs. Such programs plus memoranda of understanding should favour Canadian-owned companies and only those foreign controlled firms having genuine world-product mandates.

7. Governments should expand existing successful programs such as those of NRC (Technical Information Service) and university liaison offices that assist small and medium-sized enterprises and large businesses to acquire, apply, and develop technology. Particular attention should be paid to enhancing the capability of provincial research organizations, community colleges, as well as universities, to meet the technology, management, training, and human resource needs of SMEs and large businesses.

8. It should be a major aspect of a federal science policy to act in support of provincial initiatives by placing a greater emphasis on technology development in federal/provincial agreements.

9. Government policies to encourage the formation of more pre-venture and venture capital must be strengthened. As examples: some portion of provincial pension funds should be set aside for this purpose rather than used to finance deficits as is done in some provinces; and venture capital company profits sould be taxed only at capital gains rates.

Theme 3: Involving All Canadians and Adapting to Change

Proposition

1. Economic programs based on science and technological advance will meet with legitimate resistance if the costs and benefits are seen to be unfairly distributed. As wealth-creating industries become more productive and less labour-intensive, there will be a need for social policies that ensure equal opportunity and equitable distribution of income.

2. Many citizens see technology as destroying jobs and the environment, therefore, technological change should be cooperatively implemented wherever possible by involving all concerned parties from the very beginning and on an on-going basis. This process could be helped by the amendment of (a) labour legislation (on issues such as the definition of technological change; advance notice; consultation; and health and safety standards) and of (b) environmental legislation (on issues such as toxic waste management and pollution control).

3. New technologies will affect the quality and quantity of employment. The burden of change could be eased by paid educational leave and by the creation of a legislated right to be re-trained.

4. As a society, we must develop new techniques to study and report on the costs and benefits of technological change. Increased new funding for social and behavioural scientists and studies of the implications of technological change by specialized research institutes is needed.

5. Training in entrepreneurship and in the management of technology development and innovation is almost completely neglected. University faculties of engineering and management, community colleges and technical institutes must rectify this educational omission. In addition, institutes of higher education, in association with business, should establish short training programs in these areas for people already in the workforce.

6. As science and technology decisions affect all Canadians in a fundamental way, it is important that courses on science and technology and their impact on society be a major area of study in Canadian universities.

7. For Canada to cope with social changes, its citizens need the best general education possible -- an education comprising not only the traditional basics of language and mathematics, but also the new basics of our contemporary culture: science and technology and their relationship to society. In particular, science education should be guaranteed in every elementary school.

8. Only an informed public can be counted on to maintain social stability in the face of rapid change. As science and technology are major parts of modern culture, Canada should have a broad variety of tools for communicating to the public the interactions between science, technology, and society. This would include more museums or science centres, a national magazine on science issues, as well as the encouragement of existing voluntary organizations.

9. Governments should recognize and state clearly that science and technology are crucial to economic development, and should establish a mechanism whereby science and technology are represented at the highest level of cabinet decision-making.

DOCUMENT: 830-220/050

NATIONAL SCIENCE AND TECHNOLOGY POLICY FORUM

CONFÉRENCE NATIONALE SUR LA POLITIQUE SCIENTIFIQUE ET TECHNOLOGIQUE

WINNIPEG, Manitoba
June 8-10, 1986

WINNIPEG (Manitoba)
du 8 au 10 juin 1986

LIST OF PUBLIC DOCUMENTS

LISTE DES DOCUMENTS PUBLICS

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
830-220/001	Secretariat	Final Agenda
	Secrétariat	Ordre du jour définitif
830-220/002	Secretariat	Notes on Meeting Arrangements
	Secrétariat	Résumé de l'organization matérielle
830-220/003	Secretariat	Final List of Delegates and Observers
	Secrétariat	Liste finale des délégués et observateurs
8[illegible]-220/005	Assoc. for Advancement of Science in Canada	Towards a Cultural Base for a Science and Technology Policy
830-220/006	Assoc. of Canadian Community College	Response to the Draft Paper "Building our Strengths"
	Assoc. des collèges communautaires du Canada	L'Ébauche du document intitulé "Les moyens de notre avenir"
830-220/007	Assoc. of Cdn. Univ. for Northern Studies	The North in a National Science and Technology Policy
	Assoc. univ. canadiennes d'études nordiques	La politique nationale des sciences et de la technologie et le nord

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
830-220/008	Assoc. of Provincial Research Organizations of Cda. Inc.	The Development of a National Science and Technology Policy
830-220/009	Cdn. Advanced Tech. Assoc.	Forum on a National Science and Technology Policy
	Assoc. Cdn. de tech. avancée	Conférence nationale sur la politique scientifique et technologique
830-220/010	Cdn. Assoc. of Physicists	Development of a National Science and Technology Policy
	Assoc. can. des physiciens	L'élaboration d'une politique nationale des sciences et de la technologie
830-220/011	The Cdn. Assoc. of University Research Admin.	Statement to the Canadian Forum on a National Science and Technology Policy
	Assoc. can. d'admin. de recherche univ.	Mémoire présenté à la Conférence nationale sur la politique scientifique et technologique
830-220/012	Cdn. Assoc. of Univ. Teachers	Executive Summary for CAUT Research and Development Document
	Assoc. can. des profs. d'université	Résumé du document de l'APCU sur la recherche-développement
830-220/013	The Cdn. Chamber of Commerce	Development of a National Science and Technology Policy - Exchange of Correspondance
830-220/014	The Cdn. Chemical Producers' Association	Towards a Science and Technology Policy for Canada
	L'Assoc. can. des fabricants de produits chimiques	Élément d'une politique scientifique et technologique pour le Canada
8[illegible] 220/015	Cdn. Council of Prof. Eng.	Canadian Forum on a National Science and Technology Policy
	Conseil can des ingénieurs	Colloque canadien sur la politique relative à la science et à la technologie

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
830-220/016	Cdn. Council of Tech. and Tech.	Submission to the National Forum on Science and Technology
830-220/017	Cdn. Fed. for the Humanities	The Humanities in Canada: Cooperative Strategies for a National Science and Technology Policy
	Féd. can. des études humaines	Les sciences humaines au Canada: Stratégies coopératives en vue d'une politique nationale des sciences et de la technologie
830-220/018	Cdn. Fed. of Bio. Societies	The Elaboration of a National Science and Technology Policy: The Participation of Biological and Medical Researchers
830-220/019	Cdn. Fed. of Independant Business	Innovation, Technology Transfer and Small Business Development
830-220/020	Cdn. Labour Congress	Summary of Discussion Paper
	Congrès du travail du Canada	Document de travail
830-220/021	The Canadian Manufacturers' Assoc.	Improving our Industrial Competitiveness
830-220/022	Cdn Research Mgt. Assoc.	The Vital Ingredients of a Science and Technology Policy for Canada
	Assoc. can. de la gestion de la recherche	Les constituants indispensables d'une politique des sciences et de la technologie pour le Canada
830-220/023	The Chemical Institute of Canada	A Science and Technology Policy for Canada
830-220/024	Corporate-Higher Education Forum	Brief Summary Statement
	Forum entreprises-univ	Déclaration Sommaire
830-220/025	Electrical & Electronic Manufacturers Assoc. of Canada	Summary of a Paper Entitled Creating the Science Environment
	Assoc. can. des manufacturiers d'équipement électrique & électronique	Résumé de la communication intitulée: Creating the Science Environment

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
8 -220/026	Fraser Institute	A Brief Reflection on "Building on Our Strengths"
	Institut Fraser	Brève réflexion sur "Les moyens de notre avenir"
830-220/027	Institute of Electrical & Electronic Engineers	How to Create Industries of Comparative Advantage
830-22-/028	The Mining Assoc. of Canada	Executive Summary of Science, Technology and Innovation in the Minerals and Metals Sector
830-220/029	The National Consortium of Scien-tific and Educational Societies	The Elaboration of a National Science and Technology Policy: The Participation of the Scientific Community
	Le Consor-tium National des sociétés sci. et pédagogiques	L'élaboration d'une politique nationale des sciences et de la technologie: la participation de la communauté scientifique
830-220/030	Pulp & Paper Research Institute of Canada	National Science and Technology Policy Forum
830-220/031	Royal Society of Canada - Academy of Science	A Brief to Minister of State for Science and Technology
830-220/032	Social Sci. Fed. of Cda.	Towards a Comprehensive Science and Technology Policy
830-220/033	Agricultural Institute of Canada	Statement to the Ministry of State for Science and Technology
830-220/034	EPYTEC Proto-types Inc.	University Based Business Incubators High Leverage Development Tools for Technology Based Industry
830-220/035	Aerospace Industries Assoc. of Canada	Discussion Paper
8..-220/036	Nat. Research Council of Canada	Input to the Federal/Provincial Science Policy Conference
830-220/037	Women in Sci. and Eng.	Submission to the Canadian Forum National Science and Technology Policy

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
8_ -220/038	Assoc. des communi-cateurs sci. du Québec	Statement for the Canadian Conference on the National Policy of Science and Technology
	Assoc. des communi-teurs sci. du Québec	Mémoire pour la conférence canadienne sur la politique nationale des sciences et de la technologie
830-220/039	Ministry of State for Sci & Tech.	Building On Our Strengths
	Ministère d'Etat chargé des sciences et de la technologie	Les moyens de notre avenir
830-220/040	Saskatoon Advanced Tech. Mgt. Committee	Developing and Acquiring New Knowledge
830-220/041	Assoc. can.-française pour l'avan-cement des sciences	Présentation French copy available
830-220/042	The Institute for Research on Public Policy	Current Research Programmes in Science and Technology
8_ -220/043	The Prof. Institute of the Public Service of Canada	A Review of Problems Affecting R&D in the Public Service
830-220/044	Government of the Yukon	Statement tabled by the Hon. Tony Penikett, Government Leader, to the National Science and Technology Forum
830-220/045	Government of the Yukon	Yukon Science Policy
830-220/046	A1 and A2 Workshop	Developing and Acquiring New Knowledge
	Atelier A1 et A2	Le développement et l'acquisition de nouvelles connaissances
830-220/047	B1 and B2 Workshop	Putting Knowledge to Work and Realizing Opportunities
	Atelier B1 et B2	Faire servir les connaissances et profiter des occasions

DOCUMENT NO. N° DU DOCUMENT	SOURCE ORIGINE	TITLE TITRE
8 -220/048	C1 and C2 Workshop	Involving All Canadians and Adapting to Change French copy available
830-220/049	Science Council of Canada	Proposition (Theme 1,2 and 3) French copy available
830-220/050	Secretariat	List of Public Documents
	Secrétariat	Liste des documents publics